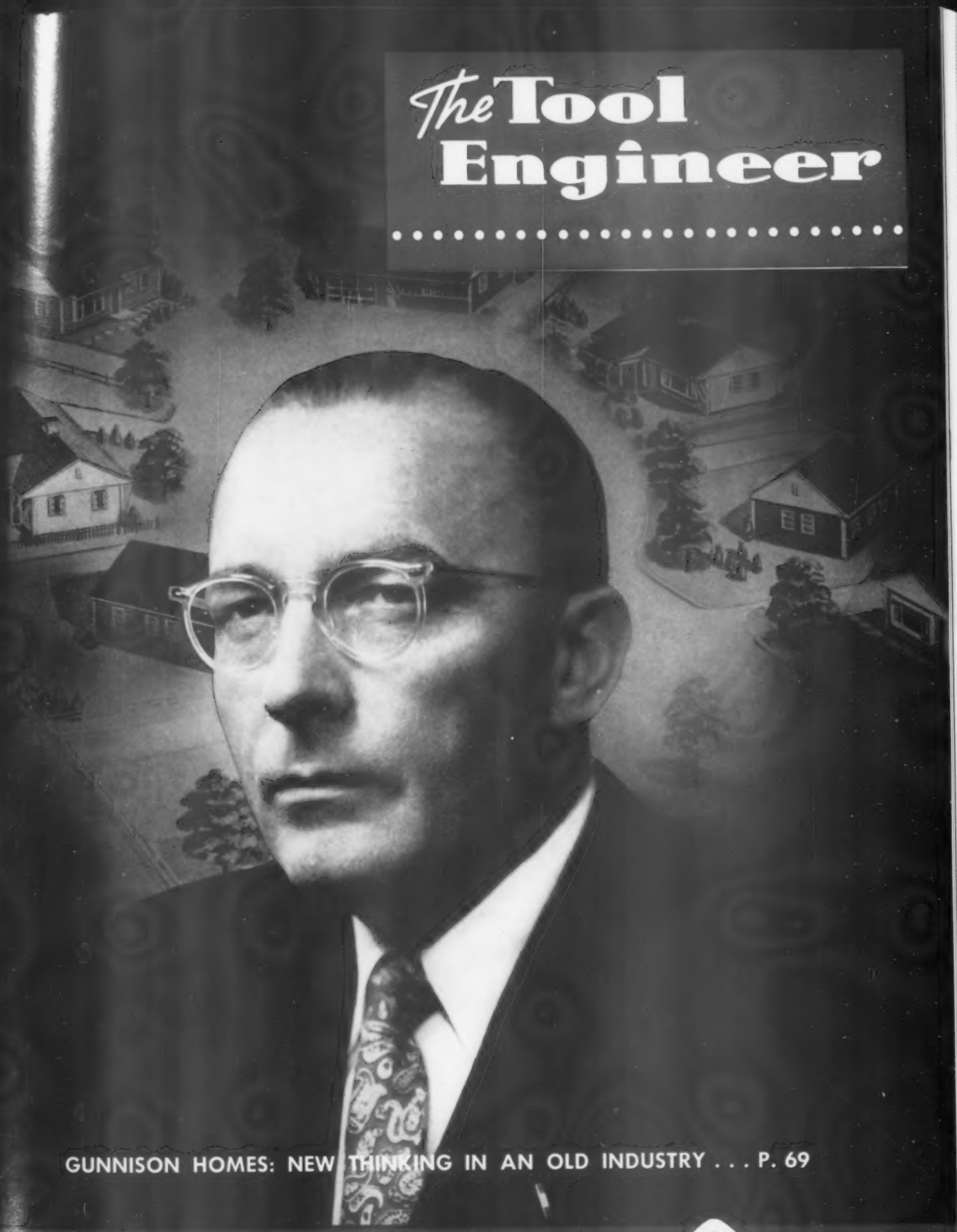
The Tool Engineer



GUNNISON HOMES: NEW THINKING IN AN OLD INDUSTRY . . . P. 69

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

AUGUST, 1952

Here's How Heald solves tomorrow's precision finishing problems today

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VOLUME XXIX
NUMBER 2
AUGUST 1952

The Tool Engineer

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AMERICAN SOCIETY OF TOOL ENGINEERS

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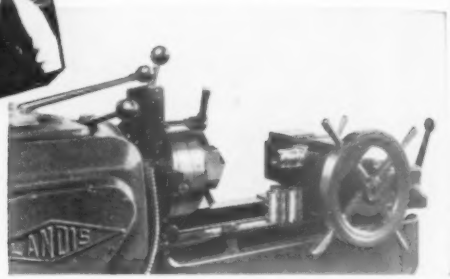

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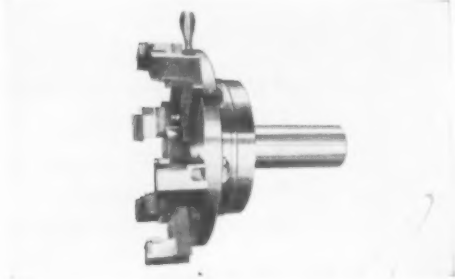

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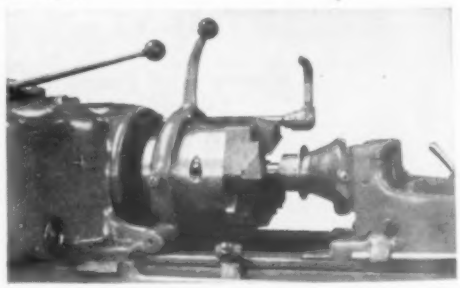

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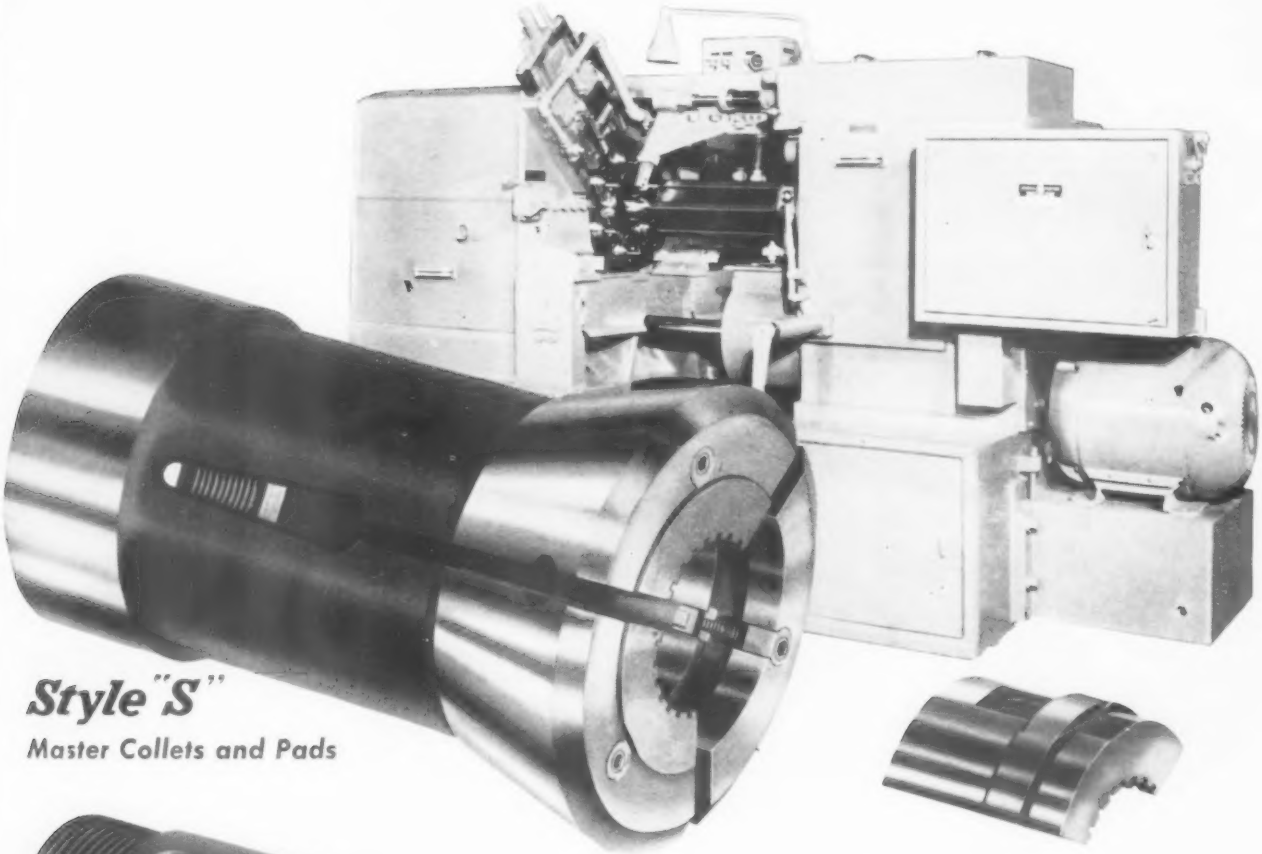

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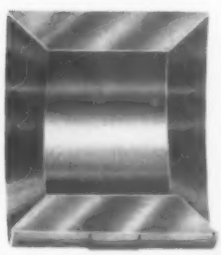

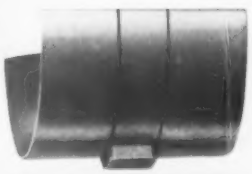

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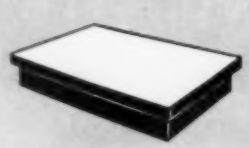
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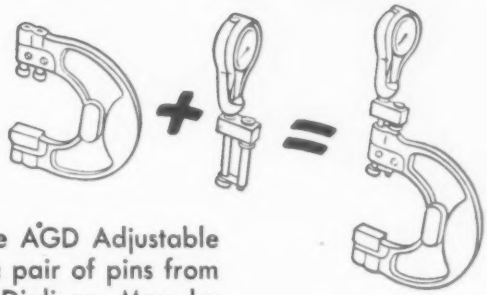

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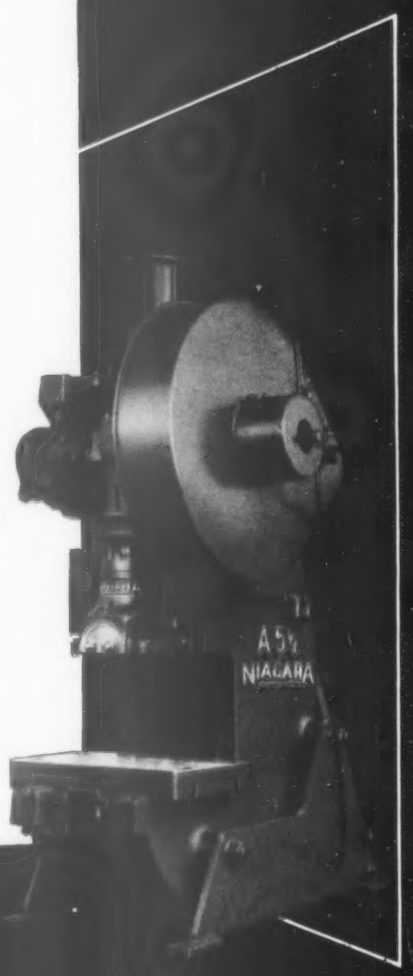

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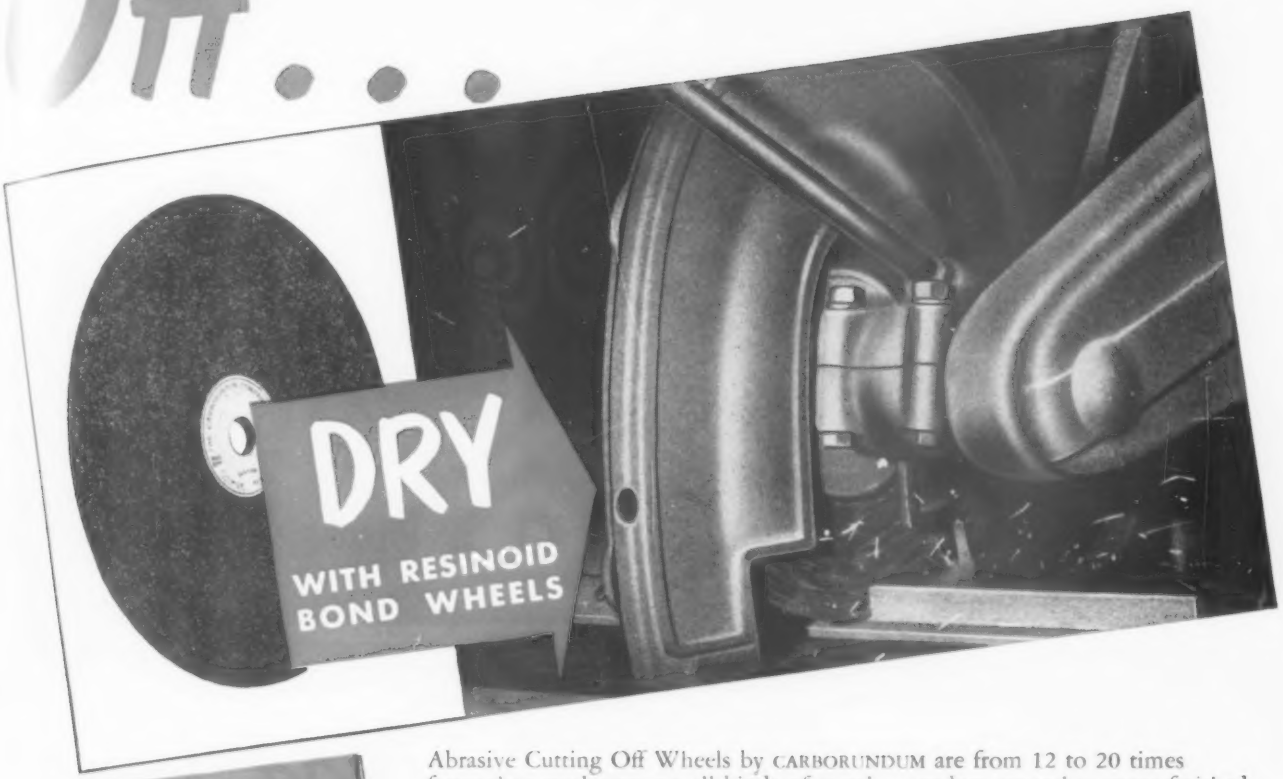

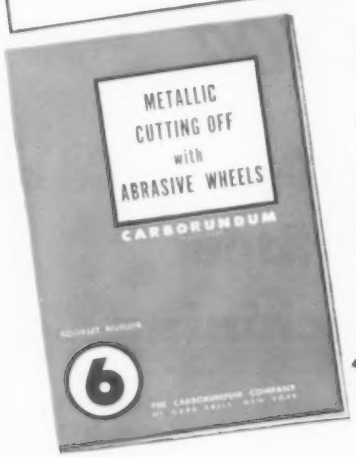

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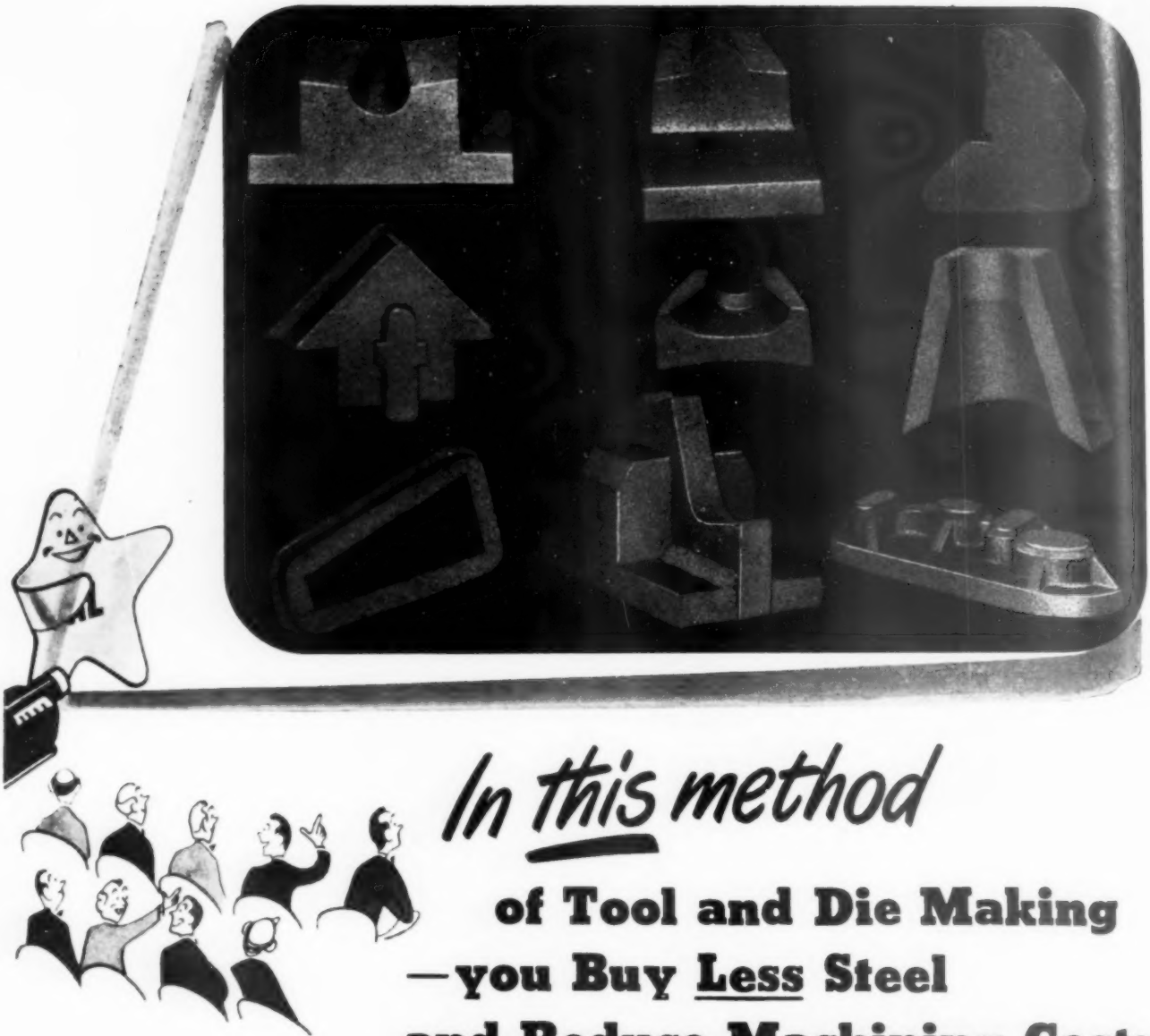

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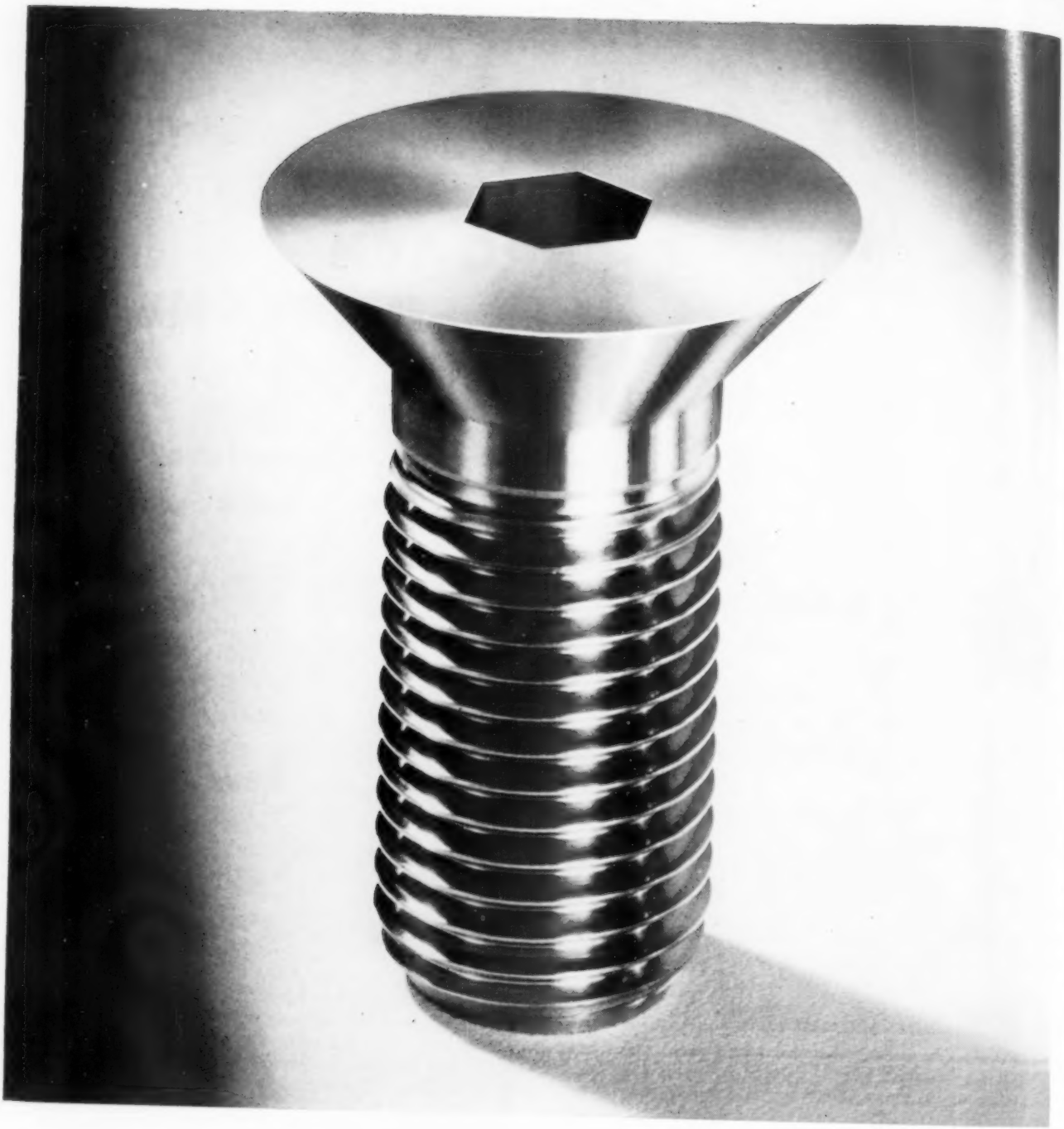

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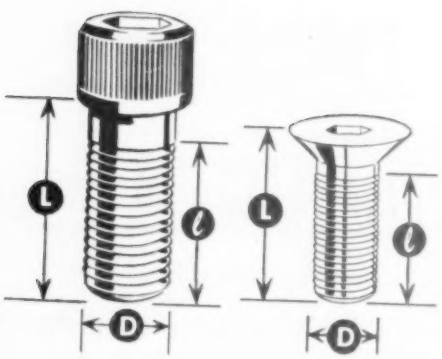

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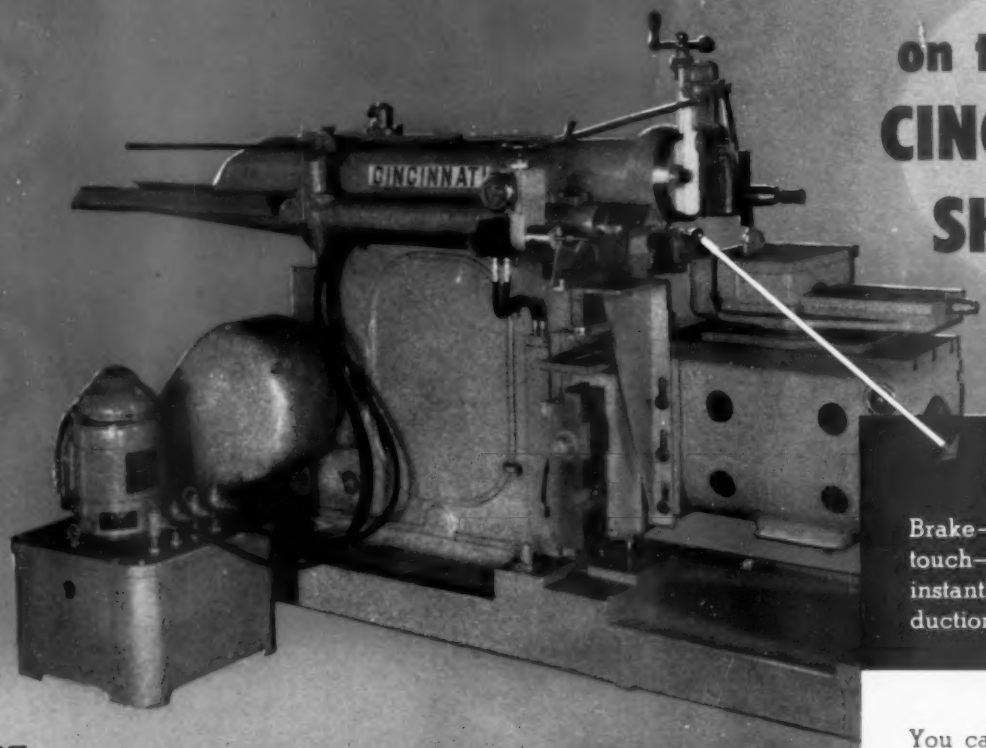

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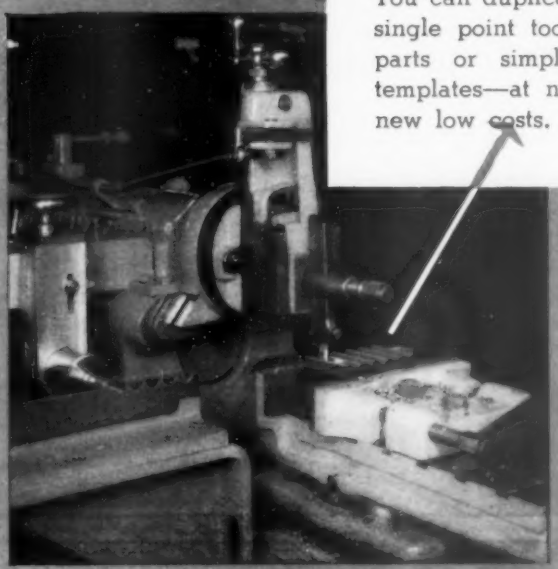

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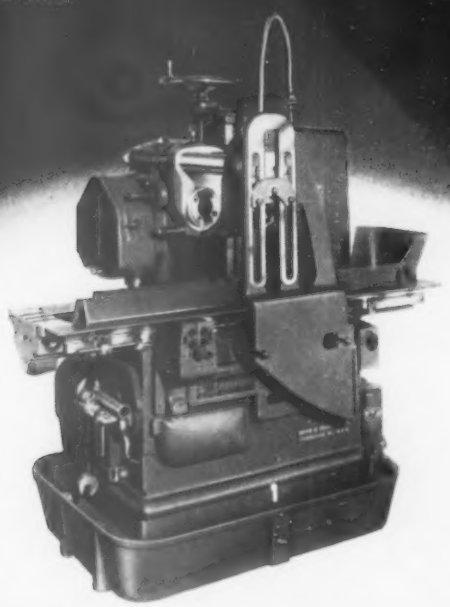

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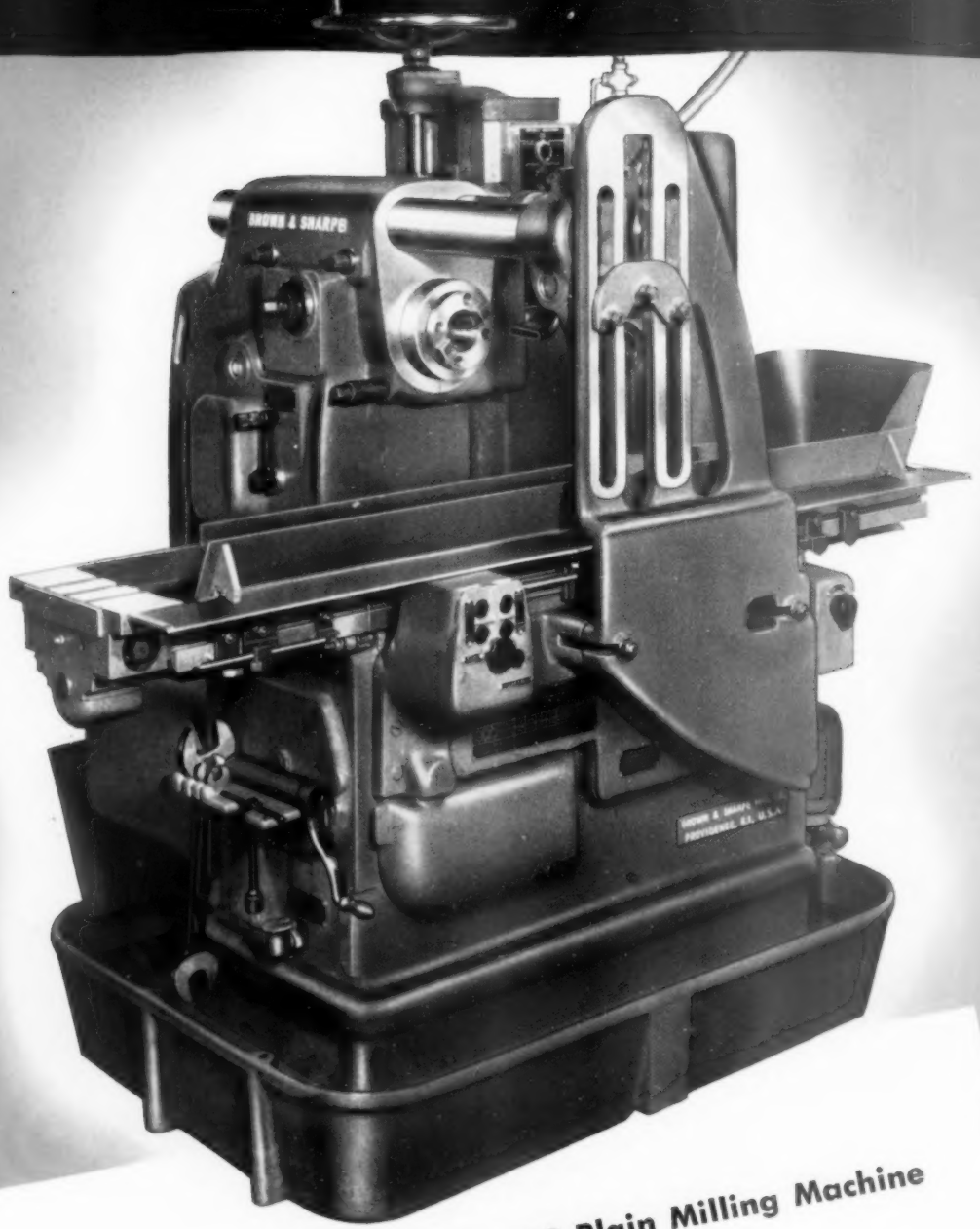

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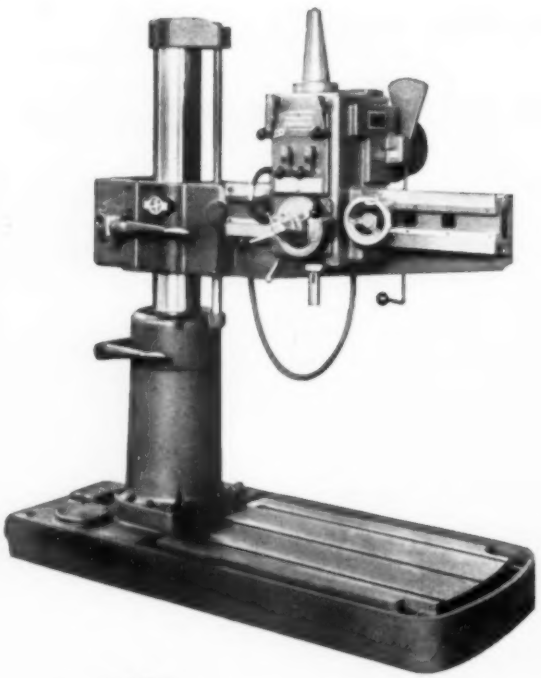

Chances are, nine-tenths of your drilling calls for 1″ diameters or less — a work range that C-O Cincinnati 3′-7″ Radials can step right into and start saving.

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And low price goes right along with well-known C-O Cincinnati quality: all-geared heads, automatic pressure lubrication, 9 spindle speeds (30 to 1 overall ratio), 6 power feeds, flame hardened transmission gears . . . all shafts mounted on antifriction bearings . . . ground tubular steel columns mounted on Timken tapered bearings . . . simple, trouble proof column and arm clamps, hardened and ground head rails on arms and extra heavy bases.

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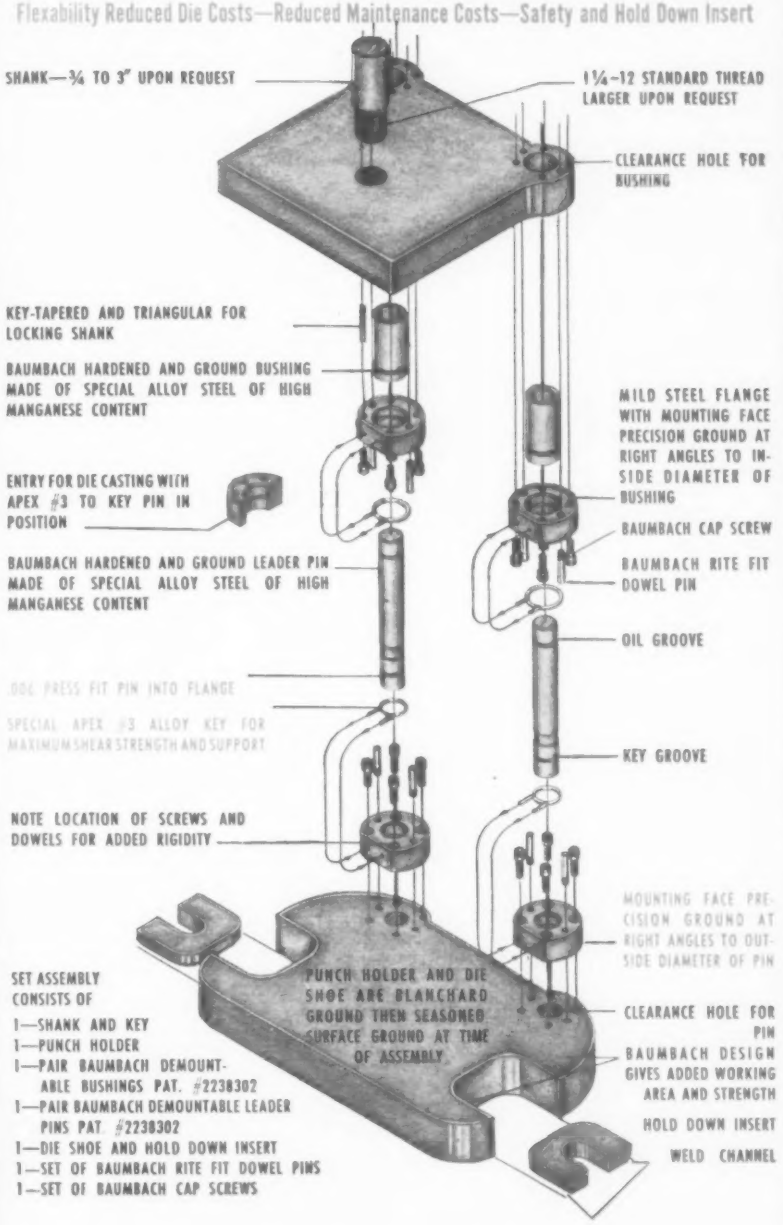
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BAUMBACH HARDENED AND GROUND BUSHING MADE OF SPECIAL ALLOY STEEL OF HIGH MANGANESE CONTENT
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KEY GROOVE
NOTE LOCATION OF SCREWS AND DOWELS FOR ADDED RIGIDITY
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PUNCH HOLDER AND DIE SHOE ARE BLANCHARD GROUND THEN SEASONED SURFACE GROUND AT TIME OF ASSEMBLY
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BAUMBACH DESIGN GIVES ADDED WORKING AREA AND STRENGTH
HOLD DOWN INSERT
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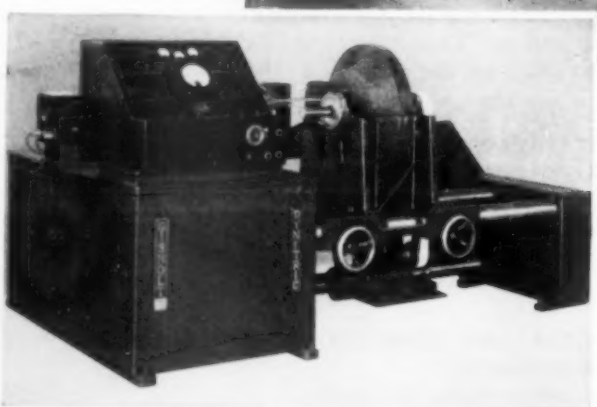

Smoothed by GISHOLT BALANCING

Heart of the jet propulsion engine is the high speed impeller (air compression member) which rotates at speeds above 15,000 r.p.m. The impeller must be free from any trace of unbalance, for at such speeds, the slightest vibration is disastrous.

Gisholt DYNETRIC Balancing Machines do the job so well that these ultra high speed rotors spin with an off-center displacement of less than .000025"! They make such a quick, easy and accurate job of it that they are used almost universally for this work.

In fact, Gisholt DYNETRIC Balancing can be used to balance anything that rotates—from ½ ounce to 50 tons. Freedom from unbalance vibration means greater safety, less wear, better service—and distinctly longer life.

**Write for free booklet "Static & Dynamic Balancing."*

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represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

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FORM-DRESS GRINDING WHEELS

Accurately.....Rapidly

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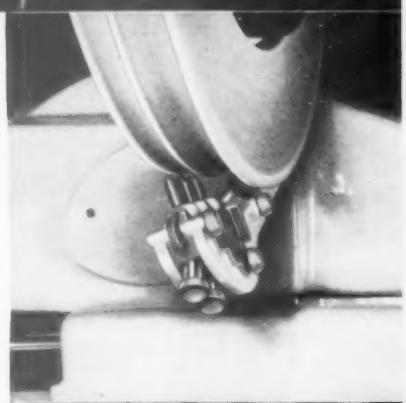

FORM GRINDING TO NEW STANDARDS OF ACCURACY . . . is easy with DIAFORM precision-dressing. You will be able to produce better dies, punches, and flat forming tools *in hours instead of days.*

The Pratt & Whitney DIAFORM attachment is a lightweight, portable instrument that provides a very fast, easy and accurate means of forming and re-trueing grinding wheels. It can be used with horizontal spindle surface grinders, and does not interfere with normal operation when left in place on the machine.

Operation is on the pantograph principle. A tracer is lightly traversed over an inexpensive template DIAFORMING even the most complex forms in a matter of minutes. Two sizes of DIAFORM are available: 1" capacity for DIAFORMING wheels up to 10" diameter using 10 to 1 reduction ratio, and 3" capacity for wheels up to 20" diameter using 5 to 1 reduction ratio. Like all Pratt & Whitney products, the DIAFORM is manufactured and inspected to conform to rigidly high standards of quality and accuracy.

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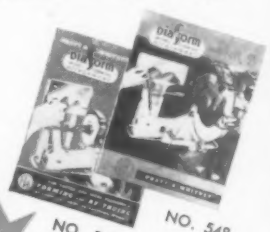
Send today for these two Bulletins. Just fill in and mail the attached coupon or write on your Company letterhead.



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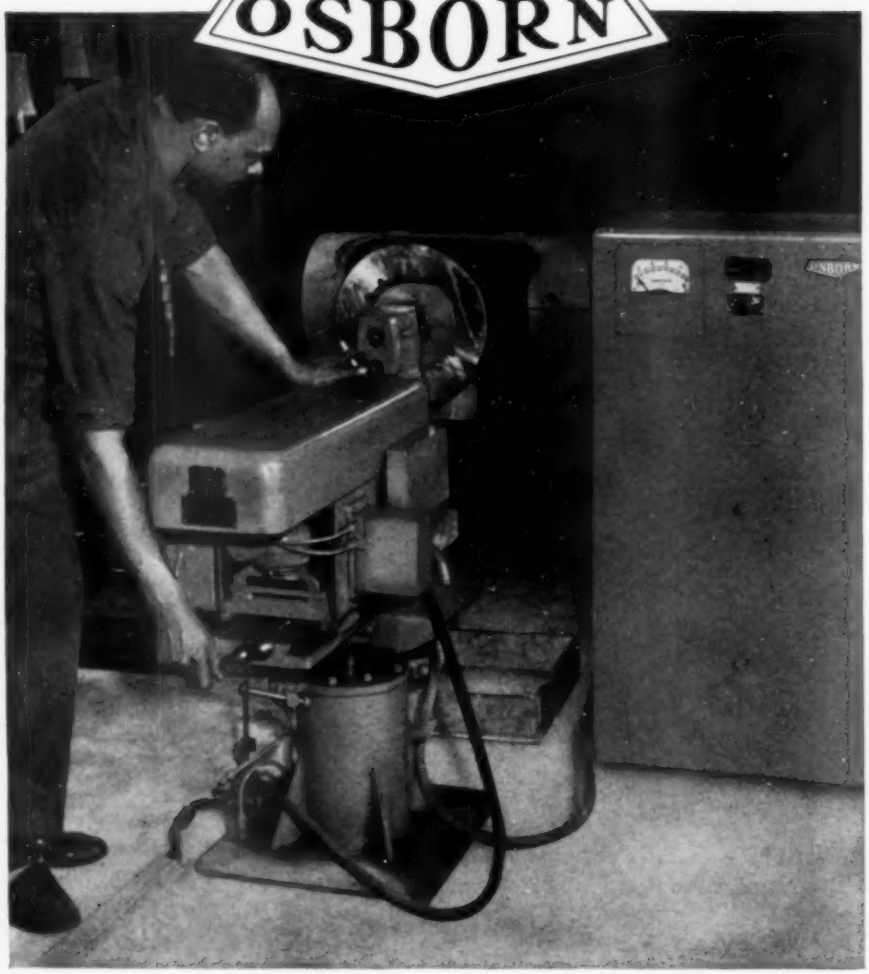
OSBORN



Deburrs gears 15 times faster at the push of a button!

Want to break a big bottleneck in the production of gears and similar parts? Manufacturers are doing just that with the Osborn Work Holder Brushing Lathe.

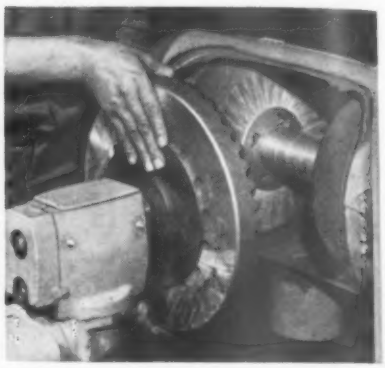
In the plant of the White Motor Company, Truck Division, Cleveland, Ohio, this Osborn machine deburrs and finishes gear teeth 1570% faster than the old method. This was done formerly with a portable grinder . . . a tedious operation that took 25 minutes for the 14-inch hypoid gears shown. Now, an operator simply places the gear in the Osborn Work Holder Brushing Lathe, pushes a button and the machine does the job automatically. Floor-to-floor time is only 1½ minutes! Uniformity of finish results in additional time savings in matching and assembly of gears.

It will pay you to investigate this high-speed, high-quality machine for deburring and finishing gears on a production basis. Call your **O**sborn **B**rushing **A**nalyst today or write *The Osborn Manufacturing Company, Dept. 791, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

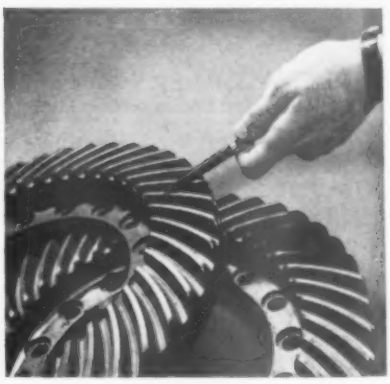
Osborn Brushes

OSBORN POWER, MAINTENANCE AND PAINT BRUSHES AND FOUNDRY MOLDING MACHINES

SET-UP IS SIMPLE. The machine is versatile. If your production involves small runs of many different types and sizes of gears and similar parts, you can specify machine settings for each part and operator can make set-up changes easily and quickly for maximum daily output. The complete brushing cycle is controlled automatically by the electronic timer which is set for any desired brushing interval to suit the size, shape or condition of part being brushed.



OPERATION IS SPEEDY. The operator mounts the gear easily and quickly. The gear advances to the face of two rotating Osborn brushes and the edge of the gear teeth makes contact with the brushes. To assure fast, positive action on each piece brushed, an automatic control reverses the direction of brush rotation on every cycle of operation.



RESULTS ARE UNIFORM. Burrs and sharp edges are removed uniformly. Every gear tooth has smooth, uniform rounded edges. Surfaces are blended.

INVESTIGATE IT TODAY

for *your* problems. Users report time savings ranging from 20% to 1570% with the Osborn Work Holder Brushing Lathe. Let us demonstrate what it can do for you!

For more efficient surface grinding at lower cost you have a wide choice of

Norton wheels, cylinders, segments

Choose Norton ALUNDUM* abrasives for surface grinding steels of all kinds, including the hard stainless steels, annealed malleable iron and the tough bronzes. The exclusive Norton 32 ALUNDUM abrasive is first choice in solid wheels or segments, particularly where rapid stock removal is an important factor.

Choose Norton CRYSTOLON* abrasives for surface grinding cast iron, chilled iron, #300 series stainless steel, nonferrous metals, nonmetallic materials, rubber and hard facing alloys.

Norton Bonds for surface grinding include vitrified, silicate and resinoid with the special "BE" vitrified bond for use with Norton ALUNDUM abrasives.

SEE YOUR NORTON DISTRIBUTOR

For the right abrasive, the *right* bond, the *right* structure for your surface grinding jobs, see your Norton Distributor. He will work directly with you, calling in a Norton Abrasive Engineer if necessary. Ask him, too, for your copy of the brand new Booklet 1632 — "The ABC of Surface Grinding" — or write us direct.

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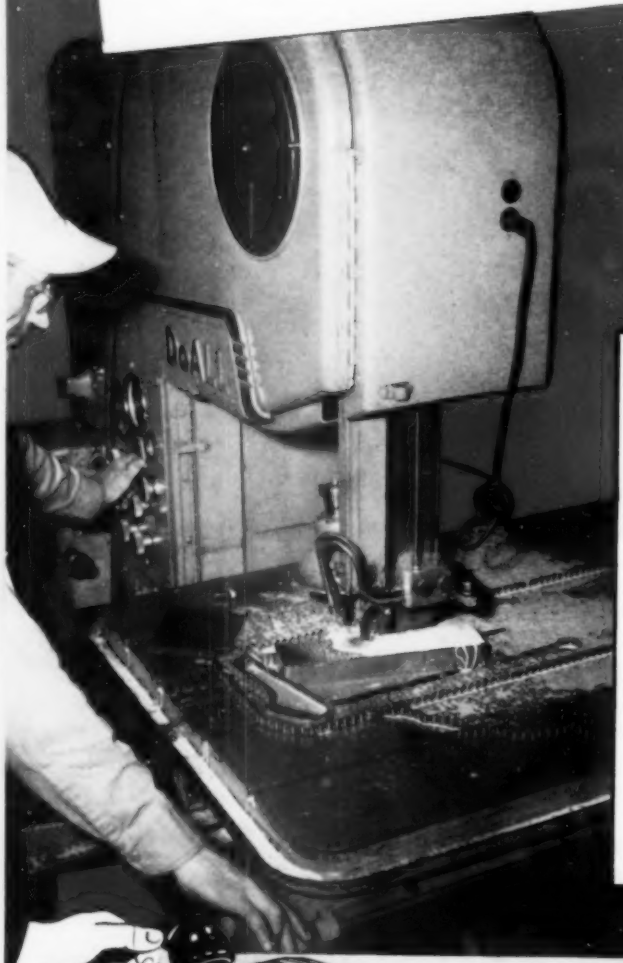
Use the DoALL method for fast low cost machining. Shape and save all types of material. Release larger expensive tools for more profitable operations.

DoALL CONTOUR-MATIC—Finest, most useful band machine built. Variable tool speed 40 to 10,000 feet per minute. Saws, files, polishes, grinds, hones, slices all materials. Hydraulic operation with finger tip controls delivers increased production at lower cost.



DoALL'S PAY PRICED AS LOW

BAND TOOLS FOR EVERY PURPOSE

—precision, buttress, claw tooth, spring temper and friction saw bands; line grind, diamond and file bands; scallop edge, spiral edge and knife edge bands; abrasive bands. Ask for catalog.

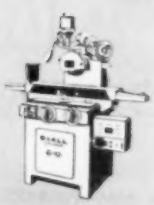
WHATEVER your band machining requirements, you can find the right model in the DoALL line. There are standard machines to meet almost every conceivable requirement: seven frame sizes; five throat sizes; speeds from 40 to 15000 f.p.m.

There is a fixed speed, 16" throat *Utility* bandsawing machine for only $350. There is a combination bandsawing, filing and polishing *Utility* model having a dual variable speed range and attached saw blade welder for only $750—*the biggest bargain available anywhere in a band tooled machine.*

There are the big, high speed DoALL *Zephyr* machines, to handle work loads weighing a ton or more and with Hydro-Feed tables for fast, labor-saving production.

The DoALL *Contour-matic* is unmatched in operational scope, quality of work and productivity.

Call DoALL
SEE YOUR CLASSIFIED PHONE DIRECTORY FOR LOCAL DoALL STORE



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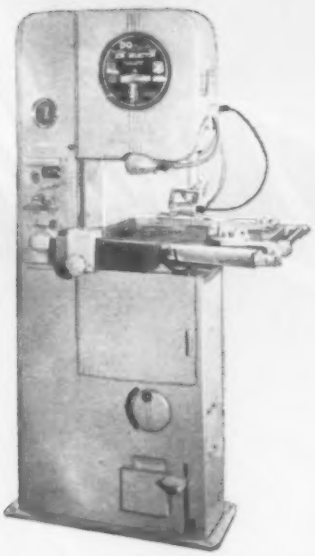
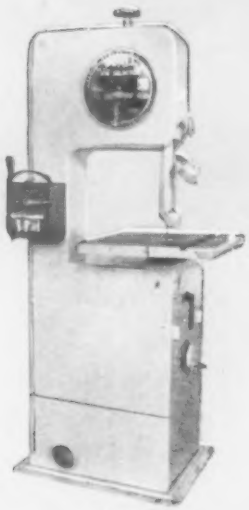
DoALL BAND MACHINING!

DoALL "ZEPHYR" MACHINES—For safe high speed sawing, up to 15,000 feet per minute. Widely used for Friction Sawing. Single or variable speed models—16″ to 60″ throat capacity. Pedal operated or automatic brakes optional on high speed machines.



DoALL CONTOUR MACHINES—For precision bandsawing, filing and polishing in every type of metal working shop. Effortless and precise control of speed and feed result in exceptionally efficient operation and reduced tool cost. Available in 16″, 26″, 36″ or 60″ throat capacity with work height under guides as required.



DoALL "UTILITY" MODELS—Light duty low cost bandsawing machines. Fixed speed for plastic or woodworking—variable speeds for more effective and economical metal sawing, filing or polishing. A dual range model combining both high and low speed control is a natural for experimental work on different materials.

IN ANY SHOP . . . AS $350

DoALL *Contour* machines are work horses of the metal shop, handling hundreds of conventional cutting jobs with accuracy and speed.

And, there are special production machines built to order for high output on your special applications.

No matter what your job, there is a DoALL Band Machine to handle it. Call your local DoALL Sales-Service Store or write:

The DoALL Company
254 N. Laurel Ave., Des Plaines, Ill.

"Band Machine Headquarters"

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DoALL

DoALL Mobile demonstration units will bring a DoALL Band Machine right to your plant and demonstrate it on your work. There is no cost or obligation. Simply "Call DoALL" locally, or write to DoALL at Des Plaines, Ill.

8-15

BLADE WELDERS

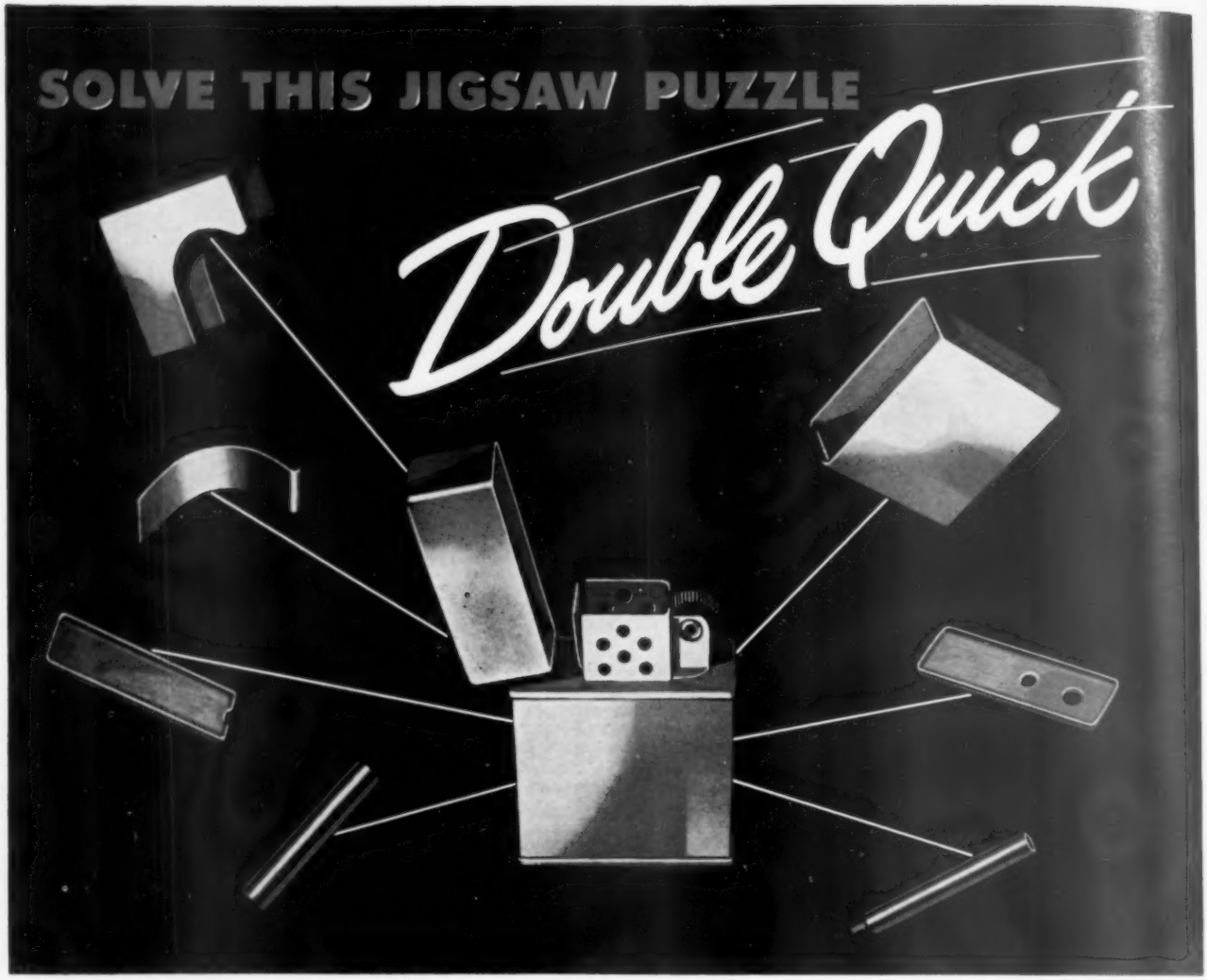
BAND FILERS

BENCH FILERS

TOOL GRINDERS

TOOLMAKER'S LATHES

TOOL STEEL



with TOCCO* Induction Soldering

The American Emblem Co. wanted to speed production, cut costs and reduce rejects in the assembly of their "Ruliter" Cigarette Ignitors. Look what happened when they switched from hand soldering to automatic TOCCO soldering!

COSTS DOWN—Solder cost reduced 50%—repairs and rework due to misalignment of parts cut 98%.

PRODUCTION UP—A 7½kw 9600 cycle TOCCO unit with conveyor type fixture heats one assembly every 20 seconds—twice the former output.

REJECTS ELIMINATED—Formerly rejects due to leaking seams and uneven heating were frequent. TOCCO has eliminated these completely.

TOCCO ENGINEERS—are glad to survey your soldering, brazing, hardening or forging requirements to see where TOCCO can save you time and money, too.

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Editorial

A Contribution Toward Understanding

Everybody believes in technological progress. Better machines, equipment and tools produce more for less. But the stockholder hesitates when there is a hint of new equipment affecting current dividends. The public is alternately impressed and amazed by automatic operations in factories, but is confused by what it all means. The worker and his union are disturbed by the new machine that replaces a couple of workers or produces more than several of the old machines put together.

Men who work and deal with the public and specifically some of the forms of the public mentioned above know that this is true—that in spite of tremendous gains we have realized from our mechanized productivity and the enthusiastic lip service we as a nation have paid to this productivity in times of emergency, there is too little understanding of its purpose and its advantages.

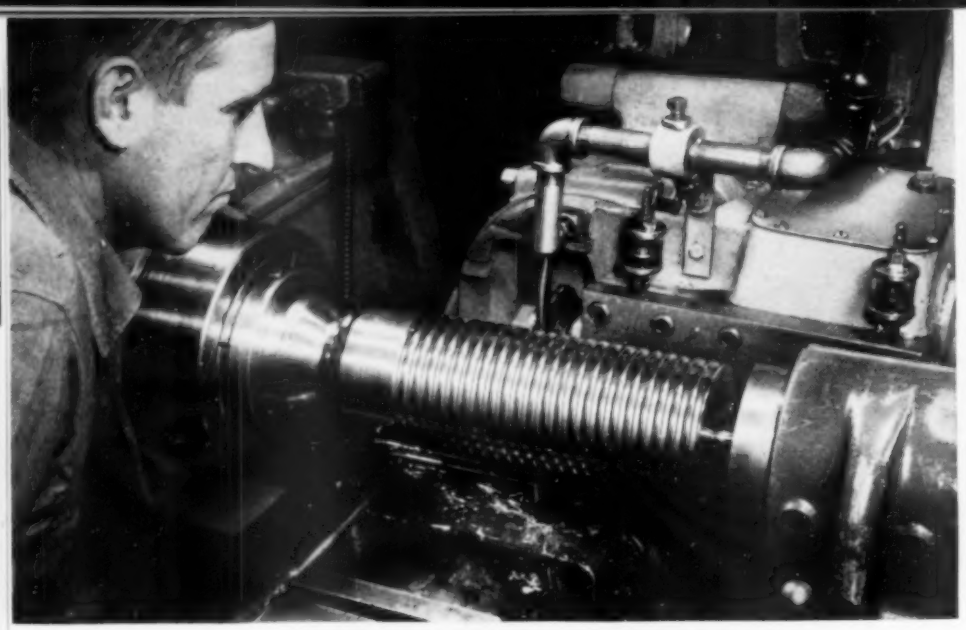
What can be done about it, and who shall do it? Certainly tool engineers are the greatest single class of originators of mass production developments. The chief beneficiary of better, cheaper and faster production is the public—ourselves and everybody around us.

Industry itself, the industries which make tools and the industries which use them, has the most to gain from better understanding by the public, and is in the best position to carry out the necessary educational program.

Proper education on this basis can lead to eradication of all the old cries of technological unemployment—and this cry will most certainly assert itself if the business index were to drop off a couple of points. Education can ease management's difficulties in getting the appropriations necessary to keep abreast of the industrial times. And it can contribute to an understanding by the consumer that the plowing back of dollars into new and better machines is the one thing that insures not only a product which he can afford to buy, but a job which will enable purchase of the product.

L. B. Bellamy

PRESIDENT
1952-1953



THREAD MILLING A SCREW. Metal: SAE 2345 steel heat-treated to 28 Rockwell • Machine: Lees Bradner thread miller • Part: 5¼" adjusting screw for press brake • Operations: rough and finish thread milling Tool: high-speed steel • Feed: 0.260 depth on roughing Cutting Oil: Sunicut 105

BROACHING A GEAR KEY-WAY. Metal: SAE 2345 steel forging 220 Brinnell • Machine: 3L8 La Pointe hydraulic broach • Part: gears for shaper, produced two at a time • Tool: 3' high-speed steel broach • Cutting Oil: Sunicut 105

SUNICUT 105 REPLACES THREE OILS AND SOLVES FIVE MAJOR PROBLEMS

Buying three cutting oils and then blending them to make additional grades had proved highly unsatisfactory to a machine tool builder. The smoke was noxious, employees complained of skin irritations, the color of the oils made it difficult to see the work, tool life was short and finishes not up to standard. To help solve these problems, the company called in a Sun representative and on his advice tested Sunicut 105 on the three tough jobs pictured here.

So good were the results that the company adopted Sunicut 105 for every machine in the plant and has used it exclusively for the past two years. The operators like its transparency. There are no complaints about smoke or skin irritations. Finishes have improved and tool life increased as much as 50 percent.

For complete information on Sun's cutting oils, write to Department TE-8 and we will send you a copy of our informative, illustrated booklet "Cutting and Grinding Facts."

CUTTING A LARGE GEAR. Metal: bronze 180 Brinnell • Machine: Gould & Eberhardt gear hobbing machine • Part: main drive worm gear wheel for large shear • 42⅝" O. D.; 5" thick; 87 teeth • Tool: high-speed steel hob • Feed: 0.006 • Speed: 42 rpm • Cutting Oil: Sunicut 105

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The Tool Engineer

a letter from the Editor

We of the American Society of Tool Engineers are both aware and proud of the fact that tool engineering is one of the broadest of the engineering fields—cutting across all boundaries of industry or process classifications.

This month, our regular report, Tool Engineering in Action, offers a specific example of the broadness of application of tool engineering principles.

We are accustomed, in the mass production branches of metalworking, to seeing high-speed automatic processes and machines operating on a production line or assembly line layout. Woodworking, however, and particularly the manufacture of homes, doesn't seem to have anything in common with the techniques with which we are familiar in the assembly of metal products.

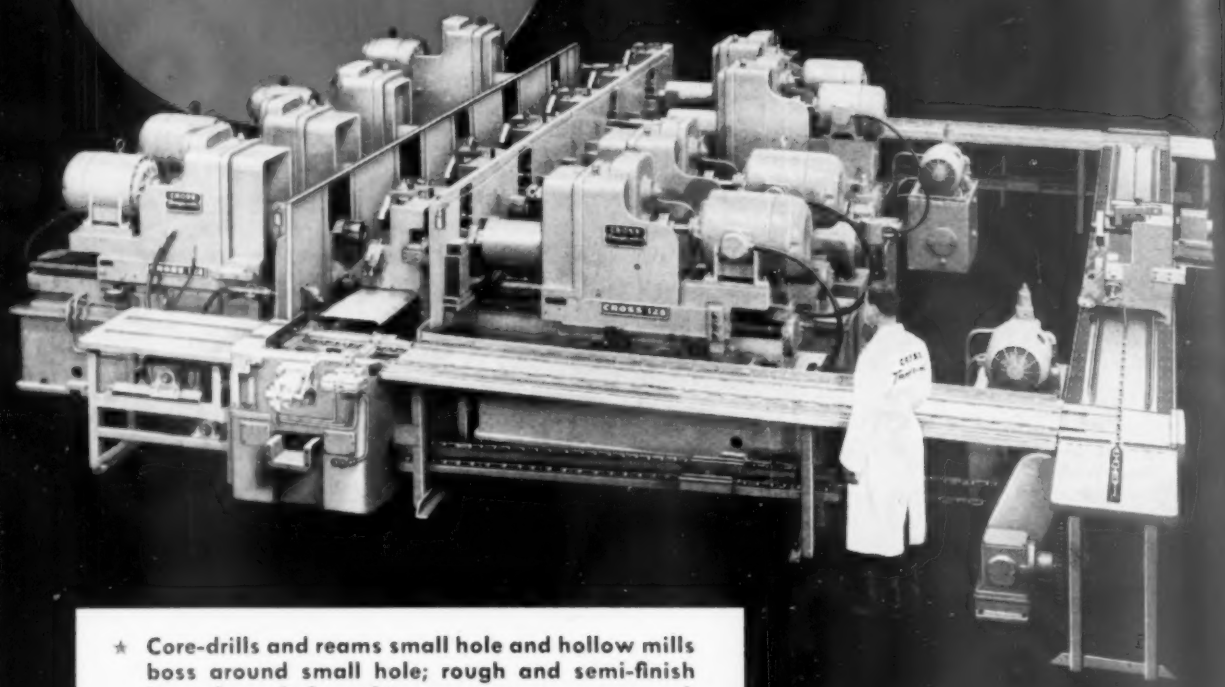
Gunnison Homes, in adapting such techniques to an old industry, has achieved for the American home what mass production and tooling techniques have done for automobiles, airplanes and appliances. Modern tool engineering principles have increased production, reduced waste, cut costs and improved quality.

The story contained in this report is another chapter in the chronology of tool engineering's contributions to our high-level economy.

Gilbert P. Muir

Bores, Hollow Mills and Trepans Tank Idler Arms

Another Transfer-matic by Cross



- ★ Core-drills and reams small hole and hollow mills boss around small hole; rough and semi-finish bores large hole and trepans groove on one end.
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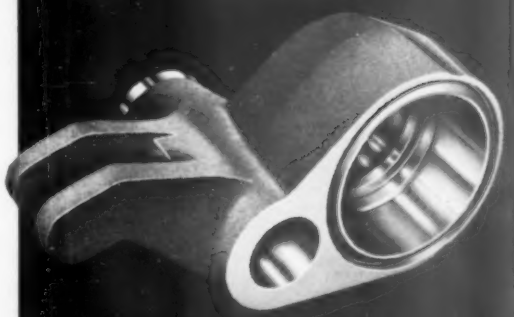

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Statistical Evaluation of Rational and Stratified Methods of Sampling

By Dr. James V. Strela
STAFF STATISTICIAN
THOMPSON PRODUCTS, INC.

Part I

PRESENTED HERE in simple terms are the fundamentals of sampling in general and of two specific methods in particular. The methods to be discussed are statistical; the logic of such methods, rather than their mathematical basis, will be emphasized. In order to facilitate the progressive development of the subject, results of the extensive collection, organization, analysis, and interpretation of numerical values constituting the content of this paper are presented graphically.

A certain amount of general theorizing about sampling is unavoidable as well as desirable. The desirability of such considerations is chiefly based on the assumption that most tool and die engineers are not primarily interested in the details of the method of quality control. Consequently, although the results of the data to be presented are subject to treatment by various methods of analysis, only the methods based on the statistical properties of the normal distribution are considered.

The basic routine associated with what is generally called the technique of dimensional control of quality is in actuality nothing but a single phase of the statistical method applicable to numerical values from innumerable mechanical, physical, biological, economical, and social phenomena.

1) If the standard of quality is unknown, an attempt is made first to determine, or closely approximate, the existing standard of quality.

2) Assuming that the standard ascertained by the statistical treatment of the past records is either satisfactory or subject to little immediate change, through an appropriate method of sampling and the subsequent method of analysis and interpretation, an attempt is made to ascertain the degree of conformance of the values subsequently produced to the past standard. There are three types of standards: (a) A well-established standard on the basis of long experience; (b) an estimated standard, usually from a rather limited sampling experience; (c) the desired standard, exemplified by the engineering quality specifications or the customer's requirements.

3) If no true or estimated standards are available, they must be estimated. Such estimates are usually made in connection with the testing of conformance to the standard desired but also to the past standard, even if such a standard is sometimes only a temporary one. However, even well-established standards are subject to change; consequently, such standards are periodically revised to establish a basis for new standards to be projected into the future.

With this preliminary presentation of the problems, the subject will be developed by describing and analyzing the nine charts which complement the contents of the paper.

Thompson Sampling Machine (Quincunx)

The Thompson sampling machine (Fig. 1), or "Quincunx," represents quite well a repetitive industrial process, for the dimensional values from any such processes are the results of the interaction of three factors represented by, or associated with, this simple device: (1) The machine itself, represented by its physical construction; (2) the material, represented by the steel balls in its bin; (3) man, setting in motion the small electric motor driving the wheel which permits one steel ball at a time to enter the 21 rows of pins above the 39 channels spaced equally with these pins, into which the balls must eventually fall.

The characteristic measured is simply variability along the scale of values represented by the spacing of the 39 channels. However, it will be helpful to think of these values as, for example, outside diame-

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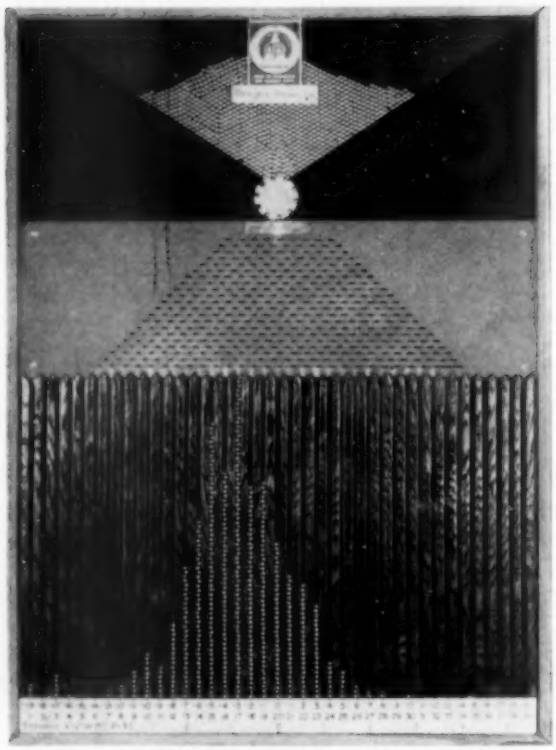


Fig. 1. The Thompson sampling machine measures the characteristic of variability along the scale of values represented by the spacing of the 39 channels. A small electric motor drives a wheel which permits one steel ball at a time to enter the 21 rows of pins above the 39 channels, spaced equally with these pins, into which the balls must eventually fall.

ters produced by a cutting operation and measured on a dial indicator set at zero at the specification mean. The next step is to establish the unknown standard characterizing the distribution of values produced by this process; or, to use more specifically statistical language, determine the true mean $\overline{X}'$ and standard deviation σ' of the statistical universe or population of measurable values resulting from the operation of the stable system of chance causes of variation inherent in this process.

Relation of Sample Size to Reliability of Standard Determination

It may safely be assumed that the production and inspection personnel associated with repetitive industrial processes are well aware of the fact that such processes are characterized by variability. However, when variability is considered, by inference, also immediately considered is a number (n) of values measured. The problem now is to illustrate the important relation of the number of the values measured or sampled to the reliability of the appraisal of the distribution pattern of the whole process. Such an appraisal may be made in two ways: on the basis of the face value of the sample, without any statistical analysis thereof; on the basis of the statistical analysis of the sample. The two methods in relation to the number of values sampled will be studied.

Standard Estimation by the "Prima Facie" Evidence of the Sample. The four organized frequency distributions, pictured in Fig. 2 as four modified bar diagrams, are based on n = 5, 50, 500, and 5,000 values consecutively taken from the Thompson sampling machine. Since in the present analysis of these progressively increasing samples no knowledge of statistical method of analysis is assumed, note that certain facts associated with this kind of superficial analysis and interpretation in reference to an assumed quality specification, $\overline{X}'_{sp} \pm \frac{1}{2}$ tolerance = Specification Mean value set at zero on the dial gage ± 10.5 on the scale of the dial gage calibration.

***n* = 5.** Although this is a very small sample, it is still larger than the one-piece inspection by which many set-up men determine whether or not the process should be run as started. Obviously, if the process is judged only by the range of this sample, it would appear that the specification would be met with considerable ease, even if the process were allowed to shift considerably above or below the specification mean. The sample shows no pronounced pattern of distribution.

***n* = 50.** If the same man who sampled the five values sampled also the 50 values, he might be surprised that the range of the first sample increased from minus 6 to plus 6, or over 12 cells or class intervals of the units of measurement on the dial gage. Consequently, he may be less sure that the specification will be easily met; he may now be more concerned about the likelihood of the level of the process shifting above or below its specification mean than he would have been from the first sample of only five values. However, he may at the same time be pleased to note that in spite of this extended range, most values of this much larger sample cluster within the range from minus 3 to plus 3, provided, of course, that he groups the 50 values into an organized frequency distribution. For we assume that this man has no knowledge of statistical method and the grouping of values by class intervals already involves the second of the four steps comprising statistical method: collection, organization (by class intervals), analysis, and interpretation.

***n* = 500 and 5,000,** respectively. If the man securing these large samples has been accustomed to judging the process variability either on the basis of a single or a few values periodically measured, he may grow progressively bewildered by this growing spread of values composing the two large samples, especially if they have been produced without any interference on his part. He may then justly ask whether there is any end to this growing spread or whether its limits would be reached if, for instance, 50,000 or 500,000, or more, such values were measured. If he notes that an exceedingly large amount of sampling reveals only an occasional

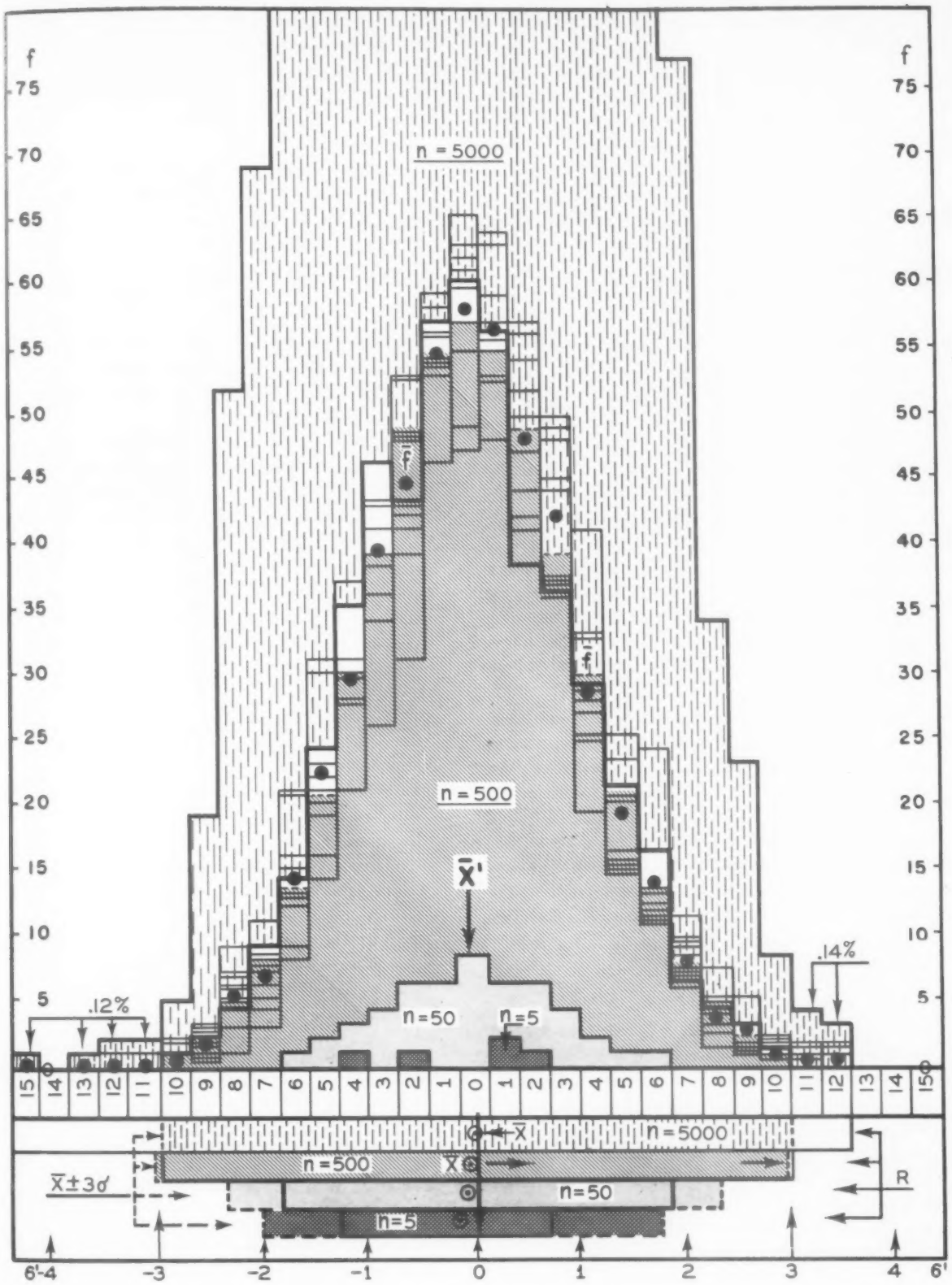


Fig. 2. Relation of n to reliability of standard determinations $(\bar{x}'\sigma')$.

value beyond a certain range of values established from a much smaller sample, he may wonder whether it is worthwhile to learn that little more about the over-all process variability if such precision is gained only at the cost of a prohibitive amount of sampling. In the case of destructive sampling, he simply could not afford relatively large samples. Obviously, a compromise concerning

the amount of sampling and the assurance resulting from it would have to be adopted.

To illustrate, although the range of the 5,000 values reveals six and seven values, minus and plus, respectively, beyond the range of the sample of only 500 values, the respective percentages of these two sets of values are only 0.12 and 0.14 percent. These fractions are so small that, for practical purposes, they may be disregarded or considered as an acceptable percentage of substandard quality. The theory on which the technique of quality control is based uses the limits of variability within which 99.73 percent of the values of a controlled process are distributed as the natural limits of variability, often referred to as process or machine capability.

Concerning this capability or natural variability, many articles have already appeared in magazines, although usually without any regard to the method of sampling or the sample size; consequently, a method of estimating them by means of statistical analysis will now be presented. However, this crude analysis is ended by emphasizing that the evidence presented suggests that although the true nature of this or any process distribution may never be known with absolute presision, for practical purposes, the pattern of the sample of 500 values told as much as the sample ten times its size; on the other hand, the sample of only five values told very little about the whole process.

Standard Estimation by the Statistical Analysis of *n* Values. More than the mere spread of the values sampled will now be considered. An attempt will be made to determine the value around which most values produced cluster and to find a measure of their degree of concentration about that central value. The respective two measures of concentration and dispersion are the mean $\overline{X}$ and the standard deviation σ of the n values X. The formulas for their calculation are

(1) $\overline{X} = \Sigma X/n$

(2) $\sigma = \sqrt{\Sigma(X-\overline{X})^2/n}$, or

(2a) $\sigma = \sqrt{\Sigma d^2/n}$ if values X are transformed into the differences, d, between them and their true arithmetic mean, $\overline{X}$. In other words σ is the root mean of the squares of the deviations of the n values X from their arithmetic mean. The symbol σ is a brief substitution for the term standard deviation, a useful measure of dispersion. There are other measures of variability besides σ; however, the standard deviation is a suitable measure of variability (scatter, or dispersion) of the values produced by a statistically controlled process. For such values distribute normally, and in the normal distribution, the dispersion within the $\overline{X} \pm 3\sigma$ spread accounts for 99.73 percent of all values; and this dispersion may be viewed as a reasonable standard, for practical purposes equivalent to the complete dispersion of the controlled process. Furthermore, if, in the long run, the distribution is known to be normal and the statistical properties of the normal distribution are known, from them the statistical properties of the averages, totals, ranges, and standard deviations of samples of n values may be inferred. The sample size figures prominently in such statistical inferences.

The analysis of the estimated process variability will now consist of determining the average and the standard deviation of the same samples previously discussed. And since the $\overline{X} \pm 3\sigma$ of a truly representative sample from a normal population should contain 99.73 percent of the sample values, such sample dispersion will be viewed as the best available estimate of the $\overline{X}' \pm 3\sigma'$ of the parent population. The symbol *prime* in this case is used to indicate the true, even if unknown, standard represented by the two values.

The average and standard deviation of a truly representative sample coincides with the mean and standard deviation of its parent population; however, since no sample is truly representative of its parent population, its $\overline{X} \pm 3\sigma$ must be expected to depart from the true $\overline{X}' \pm 3\sigma'$ of the parent population. Still, the sample shortcomings have a certain pattern of stability which is the consequence of the shape and stability of its parent population. Because of this relationship, the sample may be viewed as a skeleton of a complete specie (normal distribution), and the statistical method (which consists of the tools developed from the intimate knowledge of the statistical properties of the normal distribution) may be viewed as a modern technique by which the outline of the body is reconstructed.

It should be pointed out that the terms statistical universe or population, when applied to the output of industrial operations, are to be viewed as the statistical universe or population of the values produced by the process. In other words, depending on whether a statistical or an industrial aspect of the ideas considered in the paper is emphasized, the two terms will be used interchangeably. Naturally, even this compromise approach to the term universe assumes a very large number of values. In purely statistical language, a statistical universe or population consists of an infinitely large number ($N = \infty$) of values produced by a stable system of chance causes of variation. A universe (or process) so defined is never realized on the basis of mere sampling and thus can only be estimated.

To return to Fig. 2, the horizontal bars on the bottom of the figure, bordered by the full heavy perpendicular lines, recapitulate the ranges of the four samples plotted above their scale of values. The widths of the bars limited by the dotted lines represent the $\overline{X} \pm 3\sigma$ of these samples. The $\overline{X}$ value of each sample is illustrated by the hollow circle with a dot in its center.

(Continued next month)

Round Work Correction for Rockwell Hardness

By **Louis Small**
PRESIDENT

and

Keith Symon
TECHNICAL ADVISOR TO PRESIDENT

SERVICE DIAMOND TOOL COMPANY

SINCE THE PROPERTY of hardness is fundamental when the relative properties of solid matter are considered, hardness should be definable in the fundamental units—length, mass, and time. Since the Rockwell test is not defined in these units, but by arbitrary Rockwell scales, the National Bureau of Standards will not recognize Rockwell hardness values. The technical societies have, therefore, established suitable test procedures. This article analyses the errors involved in the Rockwell testing of round work so that a correction chart can be developed which will be acceptable to the technical societies, and may eventually become a part of all Rockwell hardness specifications.

As often happens, hardness measuring techniques have advanced more rapidly than basic understanding. The Rockwell test measures the resistance of a material to penetration and is therefore not as positive as a destructive method which parallels the manner of possible failure in use, such as the tensile test. The corrections for round work hardness tests, however, can be explained completely in terms of fundamental mechanics.

Derived mathematically, a group of simple, easily read charts are shown in Table I which can be used to immediately correct round work Rockwell readings. These charts are then corrected by comparison with the experimental measurements of David Wallace (1)*, W. L. Fleishman and R. S. Jenkins (2), G. E. Poole and J. Hunt (3), and the calculated values of W. E. Ingerson (4). The corrections involved are almost purely geometrical and are based on the fact that the area supporting the penetrator is less for a given depth of penetration into a cylinder than for the same depth of penetration into a plane surface. This is shown in Fig. 1, which shows pictures of a spherical impression drilled at the intersection of a flat and a cylindrical surface. The diameter of the cylinder and the sides of the square are exactly equal. In Fig. 4, is shown a conical penetrator. Therefore, there must be added to the reading an amount determined by the diameter of the cylinder, its Rockwell hardness number, and the Rockwell scale used.

*Numbers indicate references given at the end of this article.

The mathematical approach is based on the theory developed by W. E. Ingerson for the Rockwell test using ball penetrators. Presented here is a simplified method of calculation and also an extension of the theory to cover diamond penetrators, which are spheroconical with an included cone angle of 120 deg and a spherical radius of 0.0079 in.

Round Work Correction for 1/16 Ball Penetrator

Step 1—Fig. 2

The equation of the cylinder is

(1) $Y^2 + (x-d)^2 = R^2$

The equation of the spherical penetrator is

(2) $X^2 + Y^2 + Z^2 = r^2$

Solve (1) for X, placing a minus sign in front of the square root to agree with Fig. 2

(3) $X = -\sqrt{R^2-Y^2} + D$

therefore

(4) $X^2 = R^2-Y^2-2D\sqrt{R^2-Y^2} + D^2$

by substituting for X in equation (2), for the equation of the horizontal area supporting the ball penetrator

(5) $D^2 + R^2 - 2D\sqrt{R^2-Y^2} + Z^2 = r^2$

from the diagram, Fig. 2, it is seen that

(6) $D = R + r - P$

and

$$D^2 = R^2 + r^2 + P^2 + 2rR - 2RP - 2rP$$

and $$\sqrt{R^2-Y^2} = R\left(1-\frac{Y^2}{2R^2}\right)$$

to a sufficiently accurate approximation when Y is small compared to R.

Substitute these values in equation (5) to secure the equation for the intersection between the ball and the cylinder in terms of penetration

$$Y^2\left(1 + \frac{r-P}{R}\right) + Z^2 = 2rP - P^2$$

Step 2

Using the approximate formula $1 + a = \frac{1}{1-a}$, when a is small, and since $r - P$ is much smaller than R

TABLE I—CORRECTION CHARTS FOR ROUND WORK ROCKWELL READINGS

STANDARD C-A-D SCALES						
DIAL READING	DIAMETER					
	¼"	⅜"	½"	⅝"	¾"	1"
	ADD TO READING					
100	0.0	0.0	0.0	0.0	0.0	0.0
90	0.3	0.2	0.2	0.2	0.1	0.1
80	0.7	0.5	0.4	0.3	0.2	0.2
70	1.2	0.8	0.6	0.5	0.4	0.3
60	1.7	1.1	0.9	0.7	0.6	0.4
50	2.3	1.6	1.2	1.0	0.8	0.6
40	3.0	2.2	1.6	1.3	1.1	0.8
30	4.0	2.9	2.1	1.8	1.5	1.1
20	5.1	3.7	2.8	2.3	1.9	1.5
10	6.6	4.7	3.8	2.9	2.4	2.0

SUPERFICIAL 15N-30N-45N SCALES						
DIAL READING	DIAMETER					
	¼"	⅜"	½"	⅝"	¾"	1"
	ADD TO READING					
100	0.0	0.0	0.0	0.0	0.0	0.0
90	0.3	0.2	0.2	0.1	0.0	0.0
80	0.6	0.4	0.3	0.2	0.1	0.1
70	0.9	0.6	0.5	0.4	0.3	0.2
60	1.3	0.9	0.7	0.6	0.4	0.4
50	1.7	1.2	0.9	0.8	0.6	0.5
40	2.3	1.6	1.2	1.0	0.8	0.6
30	2.9	1.9	1.5	1.2	1.0	0.7
20	3.4	2.2	1.8	1.4	1.2	0.8

STANDARD B-F-G SCALES						
DIAL READING	DIAMETER					
	¼"	⅜"	½"	⅝"	¾"	1"
	ADD TO READING					
100	3.1	2.2	1.6	1.3	1.1	0.8
90	4.1	2.9	2.2	1.7	1.4	1.1
80	5.1	3.5	2.7	2.1	1.7	1.4
70	6.0	4.2	3.2	2.6	2.1	1.6
60	7.0	4.9	3.7	3.1	2.6	1.9
50	7.9	5.5	4.2	3.5	2.9	2.2
40	8.9	6.1	4.7	3.9	3.2	2.4
30	9.8	6.7	5.2	4.3	3.5	2.6
20	10.7	7.3	5.6	4.7	3.8	2.9
10	11.7	7.9	6.0	5.1	4.2	3.1
0	12.5	8.5	6.5	5.5	4.5	3.3

SUPERFICIAL 15T-30T-45T SCALES						
DIAL READING	DIAMETER					
	¼"	⅜"	½"	⅝"	¾"	1"
	ADD TO READING					
100	0.0	0.0	0.0	0.0	0.0	0.0
90	1.1	0.8	0.7	0.6	0.5	0.4
80	2.2	1.6	1.3	1.1	0.9	0.7
70	3.3	2.4	1.8	1.5	1.3	1.0
60	4.3	3.2	2.4	2.0	1.7	1.3
50	5.3	3.9	2.9	2.4	2.0	1.5
40	6.3	4.6	3.4	2.9	2.4	1.8
30	7.3	5.2	4.0	3.3	2.7	2.0
20	8.3	5.8	4.5	3.7	3.0	2.2
10	9.3	6.4	5.0	4.1	3.3	2.5
0	10.3	7.0	5.4	4.5	3.6	2.7

$$(7)\qquad \frac{Y^2}{\left(1-\frac{r-P}{R}\right)}+Z^2=2rP-P^2$$

Rearranging terms,

$$(8)\qquad \frac{Y^2}{\left(2rP-p^2\right)\left(1-\frac{r-P}{R}\right)}+\frac{Z^2}{2rP-P^2}=1$$

The equation for an ellipse is

$$(9)\qquad \frac{Y^2}{a^2}+\frac{Z^2}{b^2}=1$$

and its area is πab. Comparing this to equation (8), the minor axis is

$$a=\sqrt{2rP-P^2}\sqrt{1-\frac{r-P}{R}}$$

$$=\sqrt{2rP-P^2}\left(1-\frac{r-P}{2R}\right)$$

and the major axis is

$$b=\sqrt{2rP-P^2}$$

and the area of ellipse is

$$A=\pi\left(2rP-P^2\right)\left(1-\frac{r-P}{2R}\right)$$

Step 3—Fig. 3

Calculate that depth of impression in a flat surface which has the same area supporting the penetrator as that of the ellipse of equation (9). Since the equation of the spherical penetrator is

$$(10)\quad X^2+Y^2+Z^2=r^2$$

and from Fig. 3, $X=r-P'$. Then

$$Y^2+Z^2=r^2-(r-P')^2=2rP'-P'^2$$

The equation of the circle of intersection between the sphere and the plane is

$$(11)\quad Y^2+Z^2=C^2$$

Therefore, the radius of the circle of intersection expressed in penetration is found by comparing equations (10) and (11) and is

$$(12)\quad C=\sqrt{2rP'-P'^2}$$

and the area of the circle of intersection is

$$(13)\quad A=\pi C^2=\pi\left(2rP'-P'^2\right)$$

Step 4

P, the penetration into the cylinder, can now be expressed in terms of P', the penetration into the flat piece by

$$(14)\quad P'=P\left(1+e\right)$$

where e is the percentage error due to the difference in penetration in a cylinder and a flat piece then

$$(15)\quad P'^2=P^2\left(1+2e+e^2\right)$$

and e^2 can be neglected if e is small.

Compare the areas of intersection of the ellipse (9) and the circle (13)

$$(16)\qquad 2rP\left(1+e\right)-P^2\left(1+2e\right)=$$

$$\left(2rP-P^2\right)\left(1-\frac{r-P}{2R}\right)$$

which can be solved for the percentage error

$$(17)\qquad e=\frac{2r-P}{4R}$$

and in terms of penetration

$$(18)\qquad P'=P\left(1-\frac{2r-P}{4R}\right)$$

This is now transformed into a simple correction formula for the Rockwell scales using the $\frac{1}{16}$-in. ball penetrator, namely B, F and G. P, the depth of penetration in inches, is expressed in terms of Rockwell hardness reading H.

$$(19)\qquad P=0.00008\left(130-H\right)$$

The correction h to be added to the measured hardness H, on a cylinder of diameter $2R$, is now, by equation (18),

$$(20)\qquad h=\frac{P}{0.00008}\left(\frac{2r-P}{4R}\right)$$

Since $2r$, the ball diameter, is 0.0625, it is possible to substitute for $2r$ and P in equation (20)

$$(21)\quad h=(130-H)\left(\frac{.0625-.00008\left(130-H\right)}{4R}\right)$$

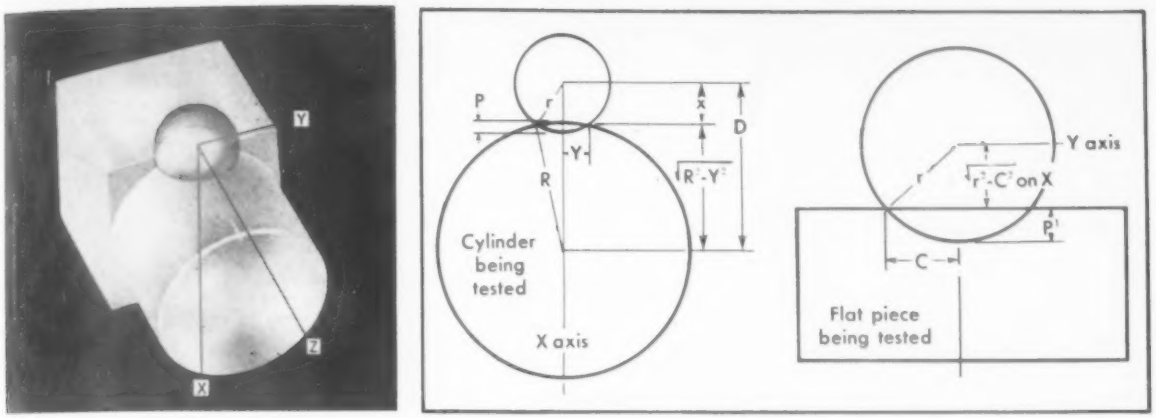


Fig. 1. A spherical impression has been drilled at the intersection of a flat and cylindrical surface. In Figs. 2 and 3, *r* is the radius of the 1/16-in. ball penetrator; *R* is the radius of the cylinder; *P* is the depth of impression of the ball in the cylinder; *Y* is the radius of the circle of intersection between the ball and cylinder; *D* is the distance between centers of the ball and cylinder; *X* is the distance between the center of the ball and the circle of intersection; *C* is the radius of the circle of intersection between the ball and the flat surface; *P'* is the depth of impression of the ball into the flat surface.

which can be arranged in the more convenient form

$$h = \frac{0.4}{2R}\left(\frac{651 + H}{100}\right)\left(\frac{130 - H}{100}\right)$$

A similar analysis can be applied to the superficial scales 15T, 30T and 45T and the correction to be added is

(22) $$h = \frac{0.2}{2R}\left(\frac{1463 + H}{100}\right)\left(\frac{100 - H}{100}\right)$$

or approximately

$$h = \frac{3}{2R}\left(\frac{100 - H}{100}\right)$$

The spheroconical shape of the diamond penetrator presents a more involved problem that can be solved with the following procedure:

First, find the correction to be applied if the diamond penetrator is purely conical in shape by the same four steps used for the ball penetrator solution. Since the tip of the actual penetrator is spherical, an additional correction must be taken into account. The correction formula (18) for a ball penetrator should be used for depths of penetration less than *c/o*, which is the depth at which only the spherical tip is penetrating the material —that is, the point of tangency between the cone and the sphere. For large depths of penetration, the correction formula for a purely conical penetrator can be used, merely subtracting the actual distance of the conical point from the spherical tip.

There will be a small intermediate range of depth of penetration where the circumference of the impression lies partly on the spherical tip and partly on the cone. In this case, the correction will be somewhere between the spherical and conical correction. These corrections are obtained by calculating corrections for small depths from the spherical correction formula, and for large depths from the conical correction formula, and then choosing correction at intermediate depths so as to join these two correction formulas smoothly. In practice, it turns out that the results join satisfactorily if the spherical correction formula is used up to about twice the depth, d_o, defined above, and the conical correction formula is used for greater depths.

Round Work Correction for Conical Diamond Penetrator

Step 1—Fig. 5

The equation of the cylinder is

(23) $$Y^2 + (D + (-X))^2 = r^2$$

The equation of the conical penetrator is

(24) $Y^2 + Z^2 = X^2 \tan^2 \alpha$, but $\alpha = 60$ deg and $\tan^2\alpha = 3$

then $$Y^2 + Z^2 = 3X^2$$

Solve equation (23) for X

(25) $$X = D - \sqrt{R^2 - Y^2}$$

Therefore

(26) $$X^2 = R^2 - Y^2 - 2D\sqrt{R^2 - Y^2} + D^2$$

By substituting for X in equation (24) the equation of the contact area supporting the conical penetrator becomes

(27) $$Y^2 + Z^2 = 3\left(D^2 + R^2 - Y^2 - 2D\sqrt{R^2 - Y^2}\right)$$

From Fig. 5

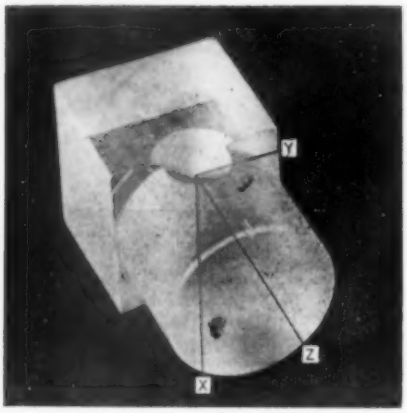
(28) $$D = R - P \quad \text{and}$$

$$D^2 = R^2 - 2RP - P^2 \quad \text{and}$$

$$\sqrt{R^2 - Y^2} = R\left(1 - \frac{Y^2}{2R^2}\right)$$

when *Y* is small compared to *R*.

It is then possible to substitute in equation (27) and secure the equation for the intersection between the cone and cylinder in terms of penetration



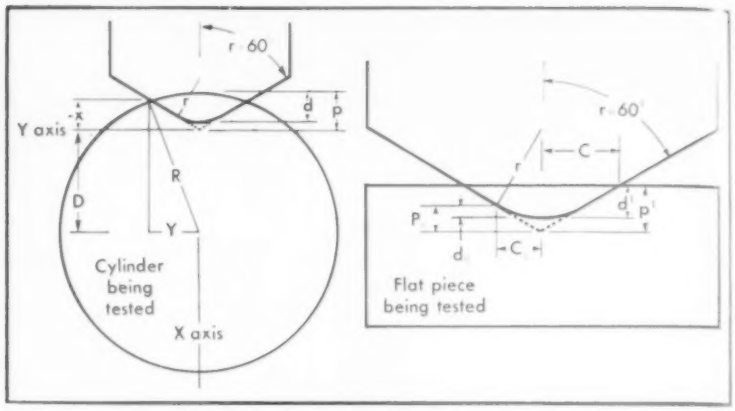


Fig. 4. Shown here is a conical impression at the intersection of a flat and cylindrical surface. In Figs. 5 and 6, *r* is the radius of the spheroconical penetrator (0.0079 in.); *R* is the radius of the cylinder; *P* is the depth of impression of the cone into the cylinder with the spheroconical radius of zero, cone penetration only; *Y* is the radius of the circle of intersection between the cone and cylinder; *D* is the distance between point of cone and center of cylinder; *X* is the distance between the point of the cone and the circle of intersection; *d* is the depth of impression of penetrator into cylinder; *d'* is actual depth of penetration in flat piece; *P'* is depth cone would have penetrated; P_o is the distance from point of cone to point of tangency between sphere and cone; d_o is distance from bottom of sphere to point of tangency between sphere and cone; C_o is radius of circle of intersection when depth of penetration is at point of tangency between sphere and cone.

$$Y^2 + Z^2 = 3\left(P^2 - \frac{Y^2P}{R}\right)$$

$$Y^2 + 3Y^2\left(\frac{P}{R}\right) + Z^2 = 3P^2$$

Step 2

Rearranging terms

$$(29) \qquad Y^2\left(1 + \frac{3P}{R}\right) + Z^2 = 3P^2$$

Since 3P is small compared to R, $\left(1 + \frac{3P}{R}\right)$ can be transposed from numerator to denominator by changing to $\left(1 - \frac{3P}{R}\right)$ and equation (29) becomes

$$(30) \qquad \frac{Y^2}{3P^2\left(1 - \frac{3P}{R}\right)} + \frac{Z^2}{3P^2} = 1$$

The equation for an ellipse is

$$(31) \qquad \frac{Y^2}{a^2} + \frac{Z^2}{b^2} = 1$$

and its area is πab.

Then comparing to equation (30), the minor axis is

$$a = \sqrt{3}P\left(1 - \frac{3P}{2R}\right)$$

and the major axis is $b = \sqrt{3}P$

and the area of the ellipse is

$$A = 3\pi P^2\left(1 - \frac{3P}{2R}\right)$$

Step 3—Fig. 6

That depth of impression in a flat surface which has the same area supporting the penetrator as that of the ellipse of equation (31) is now calculated.

Since the equation of the conical penetrator is

$$(32) \qquad Y^2 + Z^2 = 3X^2$$

and from Fig. 6, $X = P'$. Then

$$Y^2 + Z^2 = 3P'^2$$

The equation of the circle of intersection between the cone and the plane is

$$(33) \qquad Y^2 + Z^2 = C^2$$

Therefore, the radius of the circle of intersection expressed in penetration is found by solving equations (32) and (33), and is

$$(34) \qquad C = \sqrt{3}P'$$

and the area of the circle of intersection is

$$(35) \qquad A = \pi C^2 = 3\pi P'^2$$

Step 4

Equating the area of the ellipse, equation (31) and the area of the circle, equation (35)

$$(36) \qquad 3\pi P'^2 = 3\pi P^2\left(1 - \frac{3P}{2R}\right)$$

and

$$P'^2 = P^2\left(1 - \frac{3P}{2R}\right)$$

and

$$P' = P\left(1 - \frac{3P}{4R}\right)$$

which is the correction to be added to *P*, the depth of penetration in the cylinder, to find *P'*, the equivalent depth in the plane surface.

Round Work Correction Using Diamond Spheroconical Penetrator

Since in equation (36) the measurements from the end of the cone (depth *P* and equivalent depth *P'*) is shown, it is necessary to correct again because the diamond penetrator tip is actually spherical. From the diagram, Fig. 6, it is seen that the relation between P_o, d_o, and *r* can be calculated as follows:

$$(37) \qquad \frac{C_o}{P_o} = \tan\alpha = \sqrt{3}, \text{ since } \alpha = 60 \text{ deg}$$

$$\text{also,} \quad \frac{C_o}{r} = \cos\alpha = \frac{1}{2}$$

then $C_o = \sqrt{3}\ P_o = \frac{r}{2}$

and $\frac{P_o}{r} = \frac{1}{2\sqrt{3}}$ and

$P_o = \frac{r}{2\sqrt{3}} = 0.289\ r$, and since $r = 0.0079$ in.

$P_o = 0.00228$ in.

Referring again to the diagram, Fig. 6

(38) $$d_o = r - \sqrt{r^2 - C_o^2}$$

and since

$d_o = r - \sqrt{r^2 - r^2 \cos^2 \alpha} = r(1 - \sqrt{1 - \frac{1}{4}})$

$0.134\ r$ and $r = 0.0079$ in., then

$d_o = 0.00106$ in. and

$P_o - d_o = 0.00228 - 0.00106 = 0.00122$ in.

and since the difference P — d will be the same for any depth of penetration, then

$P_o - d_o = P' - d' = P - d = 0.00122$ in.

It is now possible to express the penetration of the cone, P and P', in terms of the spheroconical diamond penetration d and d'

(39) $$P' = d' + 0.00122$$
$$P = d + 0.00122$$

For small penetration, when d is less than d_o, or 0.00106, the spherical correction equation (18) is used

(40) $$d' = d\left(1 - \frac{2r - d}{4R}\right)$$

For large penetration, when d is greater than $2d_o$, or 0.00212, the cone correction equation (39) applies

(41) $$P' = P\left(1 - \frac{3P}{4R}\right)$$

and substituting from equation (39)

$$d' + 0.00122 = [d + 0.00122]\left[1 - \frac{3}{4}\left(d + \frac{0.00122}{R}\right)\right]$$

and $$d' = d - \frac{3(d + 0.00122)^2}{4R}$$

When d is between d_o and 2 d_o, the impression circumference will be partly on the sphere and partly on the cone. It is found that the corrections for depths in this range join smoothly with equation (41) if equation (40) is used up to

(42) $$d = 2\,d_o$$

It is then possible to transform into a simple correction formula for scales using a spheroconical diamond penetrator. The depth of the penetration, d, in inches for Rockwell hardness measurements on the C, A and D scales is given in terms of the hardness reading H by

(43) $$d = 0.00008\,(100 - H)$$

The correction h to be added to the measured hardness H on a round piece of diameter $2R$ is, by equation (21)

(44) $$h = \frac{3(d + 0.155r)^2}{4R \times 0.00003},$$

where $r = 0.0079$ in.

Substituting for r and d in equation (24),

(45) $$h = \frac{1.2}{2R}\left(\frac{115 - H}{100}\right)^2$$

when H is less than 70

For readings greater than 70, it is necessary to use equation (18) for a spherical penetrator, and

(46) $$h = \frac{0.79}{2R}\left(\frac{100 - H}{100}\right)$$

A similar analysis applied to the superficial scales 15N, 30N and 45N gives

(47) $$h = \frac{0.6}{2R}\left(\frac{131 - H}{100}\right)^2$$

when H is less than 40 and

$$h = \frac{0.79}{2R}\left(\frac{100 - H}{100}\right)$$

when H is greater than 40

A careful study has been made of the errors in the above analysis due to the various approximations made, and due to the neglect of the minor load impression. These errors amount to less than 10 percent of the round work correction. For a spherical penetrator (1/16-in. ball), the correction for minor load impressions cancels out; for the spheroconical penetrator (diamond), it is somewhat less than 10 percent of the round work correction. These errors have been accounted for in preparing the round work correction charts.

The largest errors are in the actual testing of round work because of the following: (1) Misalignment of the cylinder being tested in relation to the penetrator because the lead screw is not perfectly centered, or the Vee in the anvils is not properly ground; (2) improper choice of anvils; (3) improper scale is used in checking the very small rounds; (4) sample is not properly prepared, that is, the surface finish is poor or the cylinder is not perfectly round.

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Broaching of Internal Gears

By Joseph A. Psenka
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NATIONAL BROACH & MACHINE COMPANY

Part II

LEAD HAS BEEN defined for spur gears as infinity since the helix angle is zero, in which case any line passing through two corresponding points on the gear tooth face, should be parallel to the axis of rotation of the gear.

Lead and the Broaching Operation—Spur. Broaching of spur internal gears with the desired zero helix angle is dependent upon: the alignment of the puller end and the follower mechanism of the broaching machine.

The alignment is best checked by a master alignment bar which is the same length as the broach and of a constant diameter throughout its full checking length and whose ends are a wring fit in the puller and in the follower locating diameter. The alignment bar simulates the movement of the broach as it passes through the work; as the alignment bar is cycled through the length of the cutting stroke of the broach, indicators contact the alignment bar at points 90 deg apart, and any deviation from a zero reading is noted. Steps must then be taken to properly align the puller and retriever mechanisms.

Another factor is the perpendicularity of the axis of the broach to the face of the fixture upon which the location and broaching force is taken. This is checked by the use of a close-fitting sleeve on the master alignment bar carrying an indicator which sweeps the locating face of the fixture. Axial location of the sleeve on the alignment bar is maintained relative to the fixture by riding on a bushing clamped to the alignment bar by a setscrew.

Nicking of parts on the locating face because of rough handling, chips under the locating face during the broaching operation, and badly indented locating faces on soft fixtures will result in an off-lead inspection report.

Broaching of several narrow parts at one pass of the broach will result in an off-lead condition if the parts are not processed with all faces parallel. Most internal gear plants grind either one or both sides of the gear locating faces to insure parallelism.

Broaching of parts on a horizontal machine without full support of the broach in the follower mechanism until the last tooth is completely through the part will cause the broach to drop slightly when the major diameter finishing teeth are passing through the part as the broaching force is zero at that point. During the tooth generating cycle, the broaching force may be 20,000, 40,000 or 60,000 pounds, dependent on the size of the gear; this force holds the parts firmly against the face of the fixture. It is highly desirable to control the broach for alignment throughout its entire cycle with the use of a rear follower support, whether a horizontal or vertical broaching machine is used.

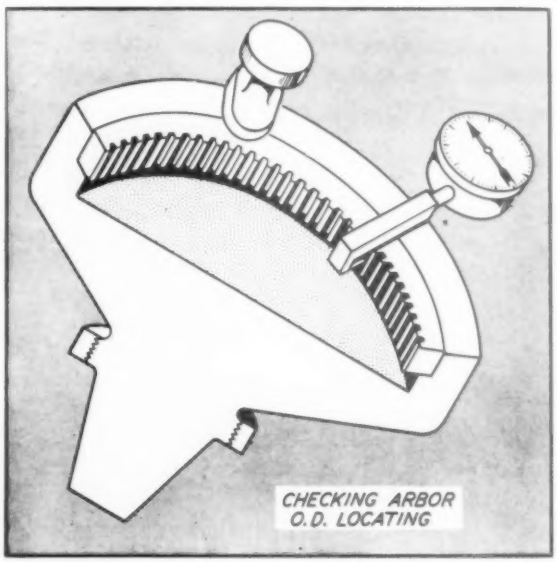


Fig. 5. Direct pitch diameter location is preferred since an involute check can be made immediately after the broaching operation without the necessity of further machining operations which may allow errors to creep into the check.

Presented at the Twentieth Annual Meeting of American Society of Tool Engineers, March, 1952.

Improperly supported parts which dish under the broaching load will result in a tapered (off-lead) tooth, since the part returns to its normal flat condition once the tremendous broaching pressures have been removed.

To minimize dishing, fixtures are left soft (Rockwell C 35-40) around the opening through which the broach passes. This hole is bored slightly larger than the starting hole in the part and the fixture is broached. The broach and the puller are provided with locating flats which insure alignment of broach, puller and the supporting teeth in the fixture during each broaching cycle.

Lead and Helical Internal Gears

Prior to the broaching method of completely finishing internal gear teeth, one of the major problems of production of helical gears with appreciable face width, where large batteries of gear shapers were used, was the non-uniformity of leads.

With 25 or 30 gear shapers generating the same internal gear, theoretically 25 or 30 different leads are produced, the off-lead condition varying with the original accuracy of the lead guide mechanism and the number of production cycles to which the lead guide has been subjected; this in turn determines the amount of wear and the necessity of replacement of the lead guide.

After the shaping operation, the internal gear teeth were shaved on gear finishing machines. As the gear finishing cutter is inherently not considered a heavy metal removal operation, and inasmuch as the internal gear shaving cutters were of an unusually small diameter, as compared to shaving cutters for external gears, leads of the internal gears were not corrected as effectively as that possible on external gears. When unusually high corrections were necessary for off-lead, shaving cutter life was appreciably reduced, further adding to the cost per piece of this operation.

This off-lead of the internal gear which would have caused end-bearing of the teeth in the assembly with resultant noise, fatigue, and wear was alleviated somewhat by the fact that the external mating teeth could be shaved with an elliptoid or crowned tooth, that is, with teeth slightly greater in thickness at the center of the face of the gear than at the outer edges, compensating somewhat for the off-lead teeth generated by the shapers and not fully corrected by the shaving operation.

Lead and Broach Manufacture—Helical. The problem of lead then became one of developing a metal-removing operation producing uniform leads. Broaching satisfied this condition, for all the helical internal gear broaches were made from a master lead bar, and the broaching machine was equipped with lead bars having the same desired lead as the broaches.

Broaching with a master lead bar consistently produces helical internal gears with leads correct within a range of 0.0000 to 0.0003 in. average, with a variation of 0.0005 to 0.0007 in. maximum.

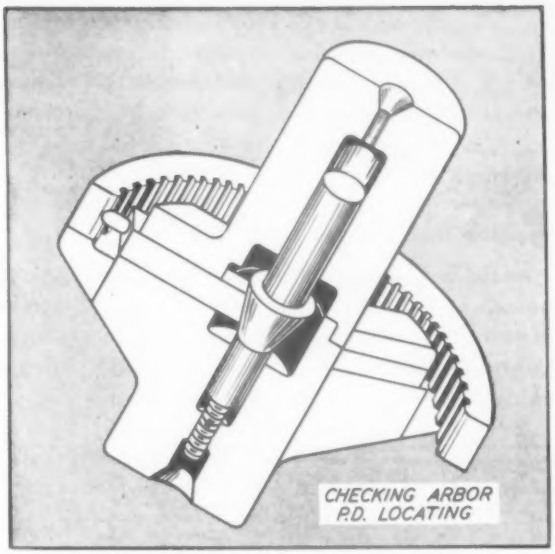


Fig. 6. In checking off the OD of the part in a pot chuck type fixture, slight additive errors may be made in the preparator OD turning operation since runout in the turning arbor or chuck will be reproduced on the part.

In the manufacture of a helical broach, a master reference lead bar is first ground on a geared head type of helical spline grinder. This reference lead bar is carefully checked, using the incremental method of checking; i.e., the checking indicator is moved axially by a calculated amount dependent upon the angle through which the lead bar is rotated about its axis.

Work lead bars are then ground from the master reference lead bar. The work lead bars actuate the broach as it passes under the grinding wheel, insuring the desired accurate and uniform leads on the broaches.

Double and opposed take-up nuts are used in the lead bar guide block which actuates the lead bar, eliminating the possibility of back-lash between the guide block and the lead bar. The master reference lead bar is stored in the lead bar library and is used only to produce work lead bars. After the finish spline grinding operation, broaches are inspected for lead on a standard lead checker to preclude the possibility of any lead errors due to any other operating conditions which might arise

Lead and the Broaching Operation—Helical. Broaching of helical internal gears with the desired helix angles requires all the precautionary measures of aligning the machine, fixture, and broaches, together with proper preparation of the gear blank as outlined for internal spur gears.

For helical gears, the master alignment bar for checking the broaching machine must be provided

with a master helical checking groove ground from the master reference lead bar used to produce the work lead bars in broach manufacture. This checking operation must be done after the machine puller and follower mechanism have been proved to be in alignment.

Spacing and Master Index Plates

As the internal gear meshes with its mating gear, the accurate spacing of the teeth will have a direct effect on the quietness of the gears. The spacing of greatest concern is the tooth-to-tooth spacing, which is held to a minimum with the broaching

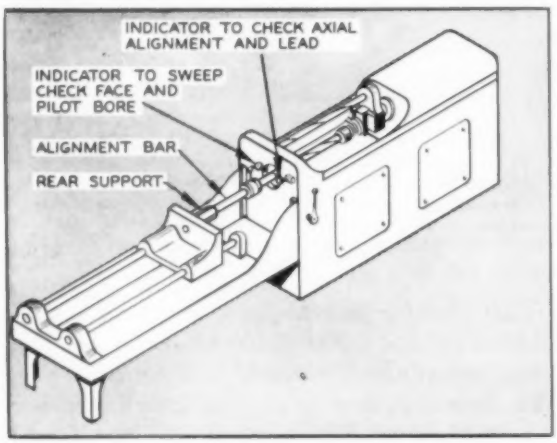


Fig. 7. A master alignment bar fixture is used to check the axial alignment and lead. An indicator sweeps the check face and pilot bore for locating purposes.

method, since broaches are spline ground, using master index plates 12 in. in diameter whose tooth-to-tooth error seldom exceeds 0.0001 in. As most broached internal gears are smaller in diameter than the index plates, spacing errors of the broach are decreased by the ratio of the diameter of the index plate to the diameter of the broach.

Size

Broach grinding tolerances are usually 0.0002 in. over pins, resulting in a broach tooth thickness size control of approximately 0.0001 in. on circular tooth thickness, varying with the pressure angle. In the life of the broach, a part tooth thickness tolerance of less than 0.001 in. is easily maintained since there is no cam back-off of the broach teeth.

If it becomes necessary to recondition broaches by spline grinding and reducing the tooth thickness, this can usually be done within the part tolerance for backlash. In the event further size reduction is necessary, the mating external gear can easily be held to its low limit within very close tolerances, since it will undoubtedly be finished by the gear shaving process.

Broaching reduces any setup errors associated with other methods of internal gear manufactu since the size accuracy is built into the broach. Th knowledge that the size of the parts of the broac can be depended upon for size uniformity also pro vides some relief for the inspection department.

Broaching internal gears of thin cross section to desired size usually calls for qualifying the OD o the blank, which is slip-fitted or lightly pressed int a retaining bushing. The bushing resists the ex pansion of the part because of the radial broaching pressures and because of the heat generated during the cutting action of the tool.

Concentricity

Broached internal gears have a minimum of eccentricity since the broach is processed from its centers. Parts not normalized prior to broaching may be eccentric after broaching because of strains released during the broaching operation.

Coolants

The two basic requirements of a coolant for internal gear broaching is that it provide ample lubrication and that it facilitate chip removal. Lubrication is necessary to protect the thousands of cutting corners on the internal gear broach which generates the involute form. Any excessive breakdown of the tooth corners will result in torn or streaky finishes on the parts. Insufficient lubrication properties may cause metal pick-up (loading or galling) on the sides of the teeth of the broach, especially on the obtuse side of helical broaches.

As in all automatically-cycled broaching operations, chip removal from the chip gullet of the broach is dependent upon the washing action of the flow of coolant upon the broach. Hence, the coolant must be such as to provide a non-adhering chip to the cutting face of broach tooth so that the coolant flow will be sufficient to remove the chips.

A ring-type coolant pipe around the broach with $\frac{1}{8}$-in. holes drilled at a 45-deg angle to provide a converging flow of coolant will most effectively wash chip off the broach. Where the type of coolant for the material being broached results in chips adhering to the broach despite the washing action of the coolant, brushing the chips from the broach, either by hand or by the use of a wire brush ring, becomes necessary.

Savings with the Broaching Method

The following is an example of the savings possible with the broaching method of internal gear production:

A manufacturer of overdrive units was using 2 single ram broaching machines, a battery of 28 gear shapers, and 4 internal gear shaving machines to meet the scheduled production of 2000 units per day.

(Continued on page 60)

Tooling With Standard Drill Jigs

By Lloyd L. Lee

STANDARD DRILL jigs have been in use for many years and are, perhaps, better known as pump jigs, from the operating action, which consists of moving a handle up to raise, and down, to lower the bushing plate.

These jigs consist of five units, a base, a bushing plate, guide bars for maintaining alignment between the bushing plate and the base, an operating handle and a locking mechanism for holding the part in position between the bushing plate and base. There are several operating mechanisms in use, roughly

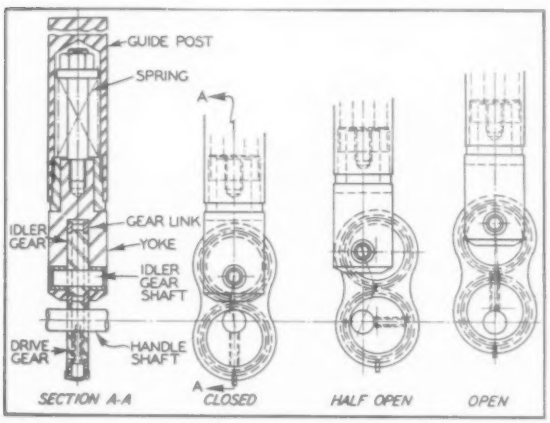


Fig. 1. A simple drill jig using the rack and pinion type of operating mechanism is shown here.

divided into two types: the rack and pinion, and the spring-loaded crank or eccentric type.

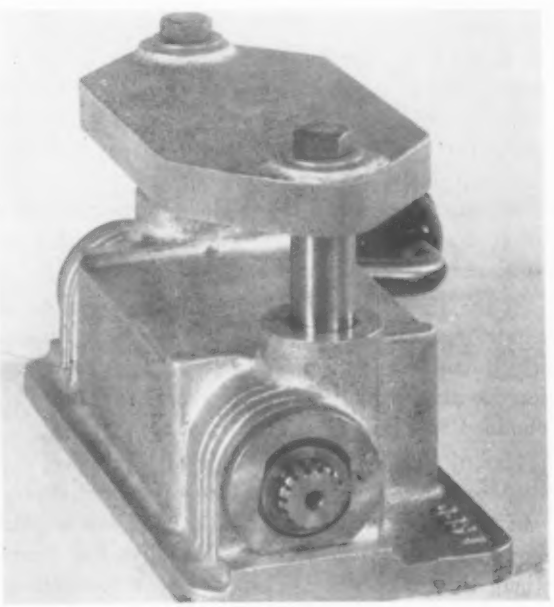
The rack and pinion is very satisfactory in combination with a suitable cam locking means. Fig. 1 shows one of the simplest of this type. The operating handle is mounted directly on the pinion shaft which meshes with rack teeth cut on the guideposts. Mounted on each end of the pinion shaft, and integral with it, are hardened bushings. Rotation of the shaft brings the bushing plate down against the work, which stops the downward travel of the guideposts. Further pressure on the operating handle tends to roll the pinion shaft upward until it is firmly wedged in the sides of the fixed bushings.

The spring-loaded type may be operated by a crankshaft or, as shown in Fig. 2, by means of eccentric gears. In this case, two gears are linked together by side plates. Each gear has a shaft hole bored eccentrically with the pitch line and the lower gear is keyed to the operating shaft. The upper gear is free to rotate about its shaft which is mounted in a yoke, which in turn can slide in the guidepost. A compression spring keeps the entire assembly together and is adjusted to exert pressure on the work when the gears are in the closed position.

Movement of the gears past center as shown in the open and closed positions in Fig. 1, effectively locks the mechanism because of the toggle action. This design allows any desired clamping pressure combined with sufficient travel to load and unload the work, and is very compact.

There are several sources for this type of jig and

Fig. 2. Eccentric gears are used to operate this spring-loaded drill jig.



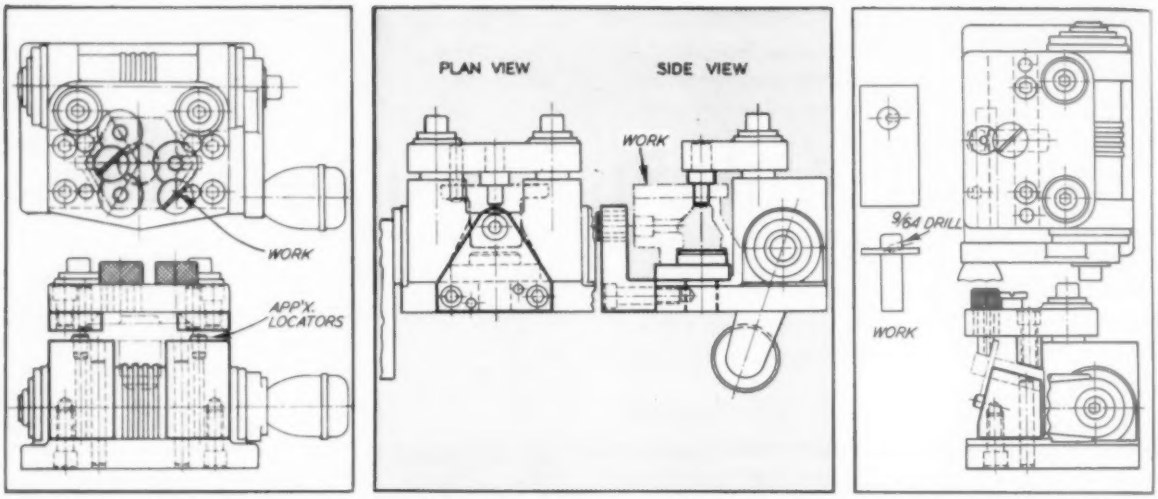


Fig. 3. (left) The heavy lines here show the adaptors and the light lines represent the standard jig. Note the approximate locators which here consist only of four pins. Fig. 4 (center) Shown here is a two-post jig laid on its back with a bushing plate attached to what would be the front of the base. Fig. 5 (right) This is a typical design for a pump jig for use on a drill press.

they are available in a wide range of sizes from the Mijit jigs, with a working surface barely a couple of inches square, to the larger jigs up to twenty or thirty inches in length. Some users, however, feel that the larger jigs are too heavy for efficient operation.

One of the basic advantages of all standard jigs is the fact that by changing adapters, or locating devices, and changing bushing plates, the main part of the jig is salvageable, therefore permitting its economical use for comparatively short runs.

Selecting a Jig

In deciding upon the jig to use for a given part, the first step is to determine the overall dimensions of the part and the location of the holes to be drilled. Wherever possible, if the part can be loaded easily, a jig with the clamping posts on center line should be selected, since the strain on the jig is not as great as in the post in rear type, and a lighter, and consequently less expensive, jig can be used. With the posts in the rear type, a much larger piece can be put in place, providing the drilling pattern is within the area of the bushing plate; and if the part extends over far enough to interfere with the operation of a side handle, these are available with handles operating from the front as shown.

If the jig is to be used on an indexing table, a single post type lends itself to the wedge shape, which conserves space. Templets and scale layouts for ease in determining the above features can be obtained from most manufacturers.

Having decided upon the type of jig to use, the simplest tooling usually consists of a preliminary locating device on the base, and a precision locator mounted on the underside of the bushing plate, where this is possible. This is only a precaution, because most jigs of this type are very accurately machined and the clamping posts are carefully fitted to act as guideposts. However, like any machine part, wear does eventually occur, and placing locators on the bushing plate insures absolute accuracy.

An example of this construction is shown in Fig. 3. The heavy lines show the adaptors, and the light lines represent the standard jig. Note the approximate locators which, in this case, consist only of four pins. When the clamping handle is moved down, the V's on the top plate relocate the part and slight pressure on the handle actuates the clamping and locking mechanism.

Another design, Fig. 4, shows a two-post jig laid on its back with a bushing plate attached to what would be the front of the base. The bushing or top plate is provided with a locator button and actuated as a vise jaw to clamp the part. A locating and rest button is located on the base which is now in a vertical position.

The drawing in Fig. 5, a typical design for a pump jig, is self-explanatory.

As will be noted, these sketches show very small parts, but the principle is exactly the same for larger pieces, the part itself determining the size jig to be used. It can readily be seen how toolroom and engineering hours can be saved and total tooling costs cut down considerably by using this type of drilling fixture, and under present conditions this is no small item.

Naturally, there are jobs that are not suited to this type of jig, particularly parts which have holes drilled in several sides where the box jig is superior, since pump jigs are not too successfully tipped around. However, the number of jobs which can be successfully done on this type of jig is large and study will usually develop a simple application.

Metal Cutting Temperatures and Tool Wear

Part II

By A. O. Schmidt
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In an analysis of different tool wear characteristics in various types of sintered carbides used in steel turning, Trent (8) advances an explanation for tool-tip temperatures. At the slower speeds the clean chip slides over the top surface of the tool, tending to weld onto it, and forming a built-up edge. Oncoming new chip material is then formed over the built-up edge and touches the carbide at a point of higher temperature which has been caused by the friction between chip and tool. At this point the chip welding tendency disappears and the chip proceeds along the tool face a short distance until a temperature in the surface layer of the tool of 2370 deg F has been reached. This is the temperature at which an alloy, having a lower melting point than either the steel or tungsten carbide, forms between the chip and the tool. The forming and wiping away of this alloy is postulated to be the mechanism of crater formation on the tool face.

Faster Cutting Speed Preferred

At faster cutting speeds a larger cratering effect can be observed due to overall higher tool temperatures. This increased tool temperature lets the cooler chip slide over the top surface without chip welding tendencies and no built-up edge appears. The temperature on and near the top surface of the tool increases progressively behind the cutting edge due to friction and eventually reaches 2370 deg F.

The phenomena discussed by Trent have been observed in steel milling tests and Fig. 9 shows a tungsten-titanium carbide tip with negative rake angles which had been cutting SAE 1020 steel at a cutting speed of 130 fpm. Remnants of the built-up edge are clearly visible near the cutting edge. When the same amount of identical steel was machined at a cutting speed of 1385 fpm using the same depth of cut and feed per tooth, the carbide tip was cratered. This crater of 0.015-in. depth can be seen in Fig. 10. The amount of material removed was 10.8 cu in. A decrease in the cutting speed to about 600 fpm would permit the removal of about 200 cu in. of material before a crater like the one shown in Fig. 10 would appear.

A tool shape as shown in Fig. 11 will diminish the amount of tool wear and also reduce the cutting forces. Since the time it was proposed in 1944 (1), this principle has been adopted quite widely in the United States and, among other things, has also been included in Russian industrial tool standards (9). Tests with this tool shape under otherwise identical conditions brought out that tool wear is decreased because of the beneficial effect of the positive rake angle behind a narrow ridge formed

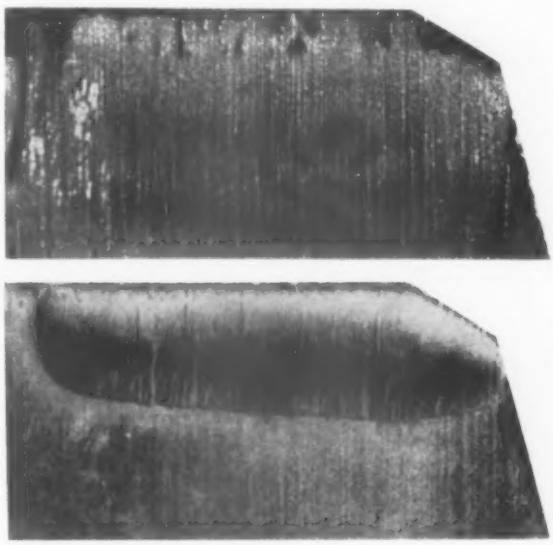

Fig. 9. (top) Carbide cutting tip with negative rake angles after milling 10.8 cu. in. of steel at 130 fpm cutting speed. Small particles on blade face are remnants of built-up edge.

Fig. 10. (bottom) Carbide tip with negative rake angles after milling 10.8 cu in. of steel at 1385 fpm cutting speed. Depth of crater is approximately 0.015.

by a negative rake angle at the cutting edge. Figs. 12 and 13 can be compared to Figs 9 and 10, since they have each gone through the same operation milling 10.8 cu in. of steel and it is clearly visible in Fig. 13 that much less cratering took

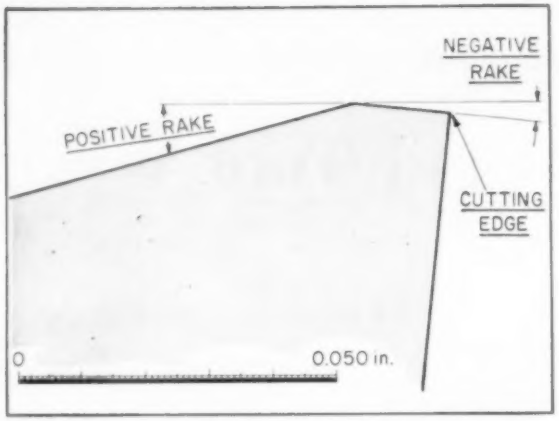

Fig. 11. Cross sectional diagram of carbide tip in a plane normal to axis of rotation. The negative ridge at the cutting edge is ground on a carbide blade placed at a positive rake angle.

place. Fig. 11 can be considered as a cross-sectional diagram of tips in Figs. 12 and 13.

The influence of the tool-tip temperatures upon tool life was investigated by Schallbroch, Schaumann and Wallichs with a tool-work thermocouple (10). They established that even comparatively slight increases in temperatures at the cutting edge

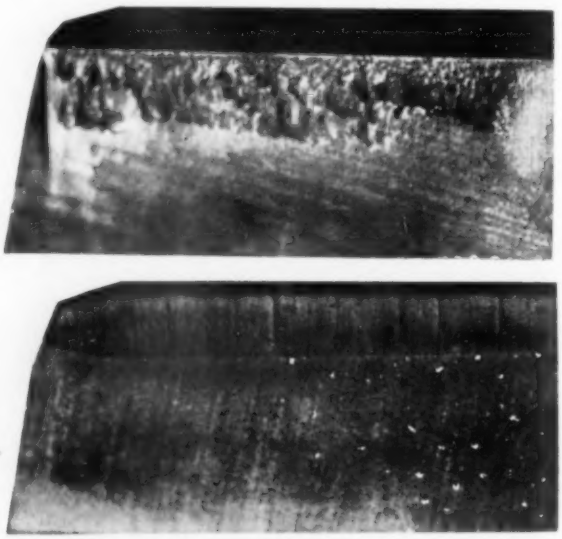

Fig. 12. (top) Carbide cutting tip (Fig. 11) after milling 10.8 cu in. of steel at 130 fpm cutting speed. Workpiece material adheres to positive radial rake face of tip.

Fig. 13. (bottom) Carbide cutting tip (Fig. 11) after milling 10.8 cu. in. of steel at 1385 fpm. Crater is less pronounced than crater in Fig. 10.

considerably reduced the tool-life of HSS tools. The same is true for carbide tools and a simple, reliable method of determining the temperature conditions in the tool will be of great help in establishing valuable metal cutting data. Thermoelectric temperature measurements and thermocolor temperature determinations give a very good indication of the temperature conditions in the cutting tool; an electrical analogy will permit further

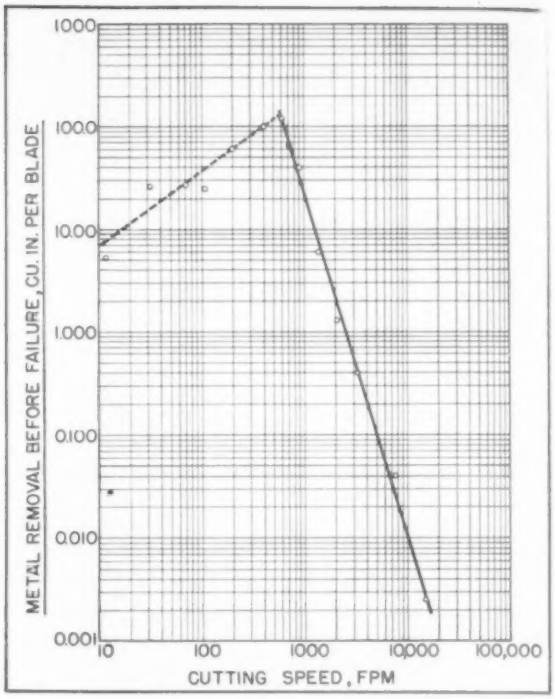

Fig. 14. (above) Effect of cutting speed on total amount of steel, SAE 1020, removed between grinds of carbide blade. Depth of cut, 0.150 in.; feed per tooth, 0.010 in.

Fig. 15. (below) Test bar used in tool life tests plotted in Fig. 16 at 7500 and 15000 fpm cutting speed.

examination of the relationship between the various temperature zones in the tool.

Several practical implications of the tests discussed here are as follows: To obtain the best production results, faster cutting speeds are to be preferred because of shorter machining time and better surface finishes. Heavier feeds are also desirable because their use entails shorter machining time. Faster cutting speeds and heavier feeds result in lower workpiece temperatures. On the other hand, faster cutting speeds and heavier feeds effect higher tool temperatures, a primary cause of tool wear and failure, and thus a very definite limit is set for these two factors.

Further, if the chip becomes too coarse it might also fracture the tool tip due to the greater forces exerted. Conversely, fine chips of 0.003 in. or less will cause much more abrasive tool wear than coarser chips. Rake angles will influence tool forces and chip flow and should be selected with discrimination. Negative rake angles are usually necessary

only when additional strength must be provided at the cutting edge of a carbide tip. However, a negative ridge superimposed upon a tip positioned at a positive rake angle will furnish added strength, result in less tool wear, easier regrinding and better adaptability of carbide tips.

How cutting speed will affect the tool life of tungsten-titanium carbide teeth, expressed in cubic inches of chips removed per blade, can be seen in Fig. 14. SAE 1020 steel of 180 Bhn was face milled at 0.150-in. depth of cut and 0.010-in. feed per tooth until either average wear of $\frac{1}{32}$-in. width appeared on the peripheral clearance surfaces of the blades or until failure by breakage occurred,

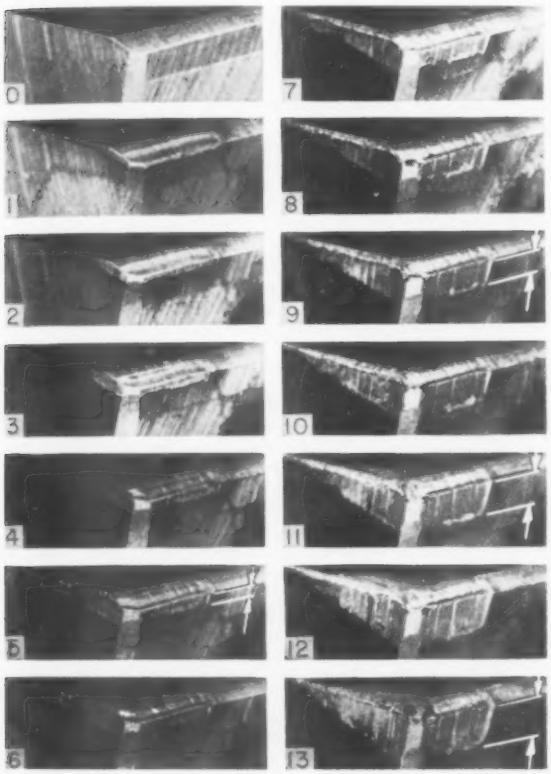

Fig. 16. Progressive wear on a tungsten-titanium carbide blade when milling 300-Bhn steel work-pieces. (Cutting speed, 428 fpm; feed, 0.0115 ipt. Each pass was 1½ in. wide, 12 in. long and 0.125 in. deep. See Fig. 18 for section and position of blades shown in photographs. Number in left hand corner indicates the number of passes completed. Arrows in 9 show 1/32-in. wear in 13 peripheral wear of 1/16 in.)

whichever happened first. Best results, i.e., 120 cu in. of chips removed, were obtained at 600 fpm cutting speed, leaving a wear mark of $\frac{1}{32}$ in. on the periphery which could be removed easily by regrinding. The same carbide tips would fail sooner by abrasion after having removed a lesser volume of chips at faster cutting speeds, due to increased wear at the higher tool temperatures. At slower cutting speeds tool failure took place more frequently by flaking and chipping of the carbide tip (11).

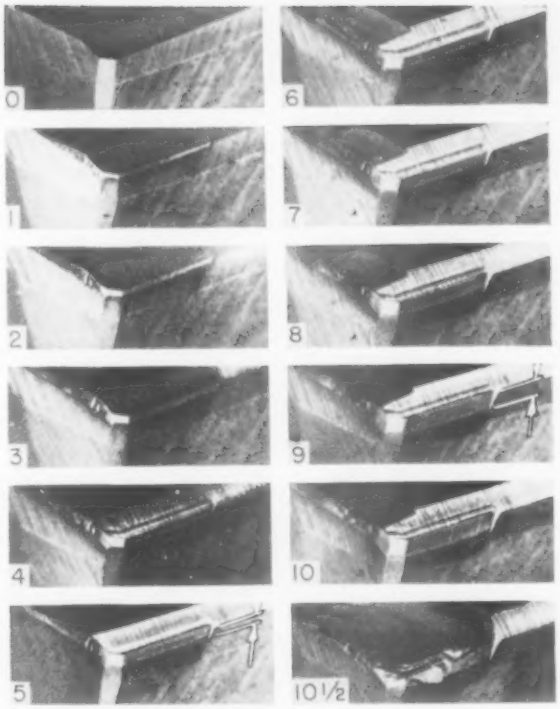

Fig. 17. Progressive wear on a tungsten-titanium carbide blade when milling 400-Bhn steel workpieces. (Cutting speed, 130 fpm; feed, 0.0045 ipt. Each pass was 1½ in. wide, 12 in. long, and 0.125 in. deep. See Fig. 18 for section and position of blades shown in photographs. Number in left hand corner indicates the number of passes completed. Arrows in 9 show 1/32-in. wear.

Very fast cutting speeds usually result in more rapid abrasion and failure of the tool whether it be made of HSS or carbide. There are cases in which faster cutting speeds than those generally recommended for either tool material are beneficial, mostly in milling comparatively light cuts. The test bar used in milling tests of Fig. 14 at 7500 fpm and 15,000 fpm cutting speed is shown in Fig. 15. Although only one cut of 0.125-in. depth was taken at 15,000 fpm cutting speed across the test bar 4 in. long and ½ in. wide, the 8-in. cutter with 10 carbide blades had completely failed. The test bar surface shows that the temperature was very high soon after the cut was started; it actually was glowing red hot and the cutter itself looked like a rotating blowtorch.

The general recommendation for machining mild steel with carbides in regard to cutting speed is usually between 300 and 800 fpm with a feed between 0.006- and 0.020-in. per tooth. Ligher feeds are used together with the faster cutting speeds when shallow cuts are to be taken and when better surface finishes are desired. The heavier feeds and slower cutting speeds are used for roughing cuts. Since light metals such as magnesium and alumi-

num alloys machine much more easily and with lower tool temperatures, it is possible to use much faster cutting speeds and still obtain very satisfactory tool life.

When machining harder steel workpieces, the cutting speeds and also the feeds are usually reduced for best production results, since more wear and often fracture of the tool tips will occur. Continuous wear on one carbide tooth of a milling cutter is shown in Fig. 16. The workpiece milled was SAE 4150 steel of 321 Bhn. A similar wear pattern was established when testing workpieces made of SAE

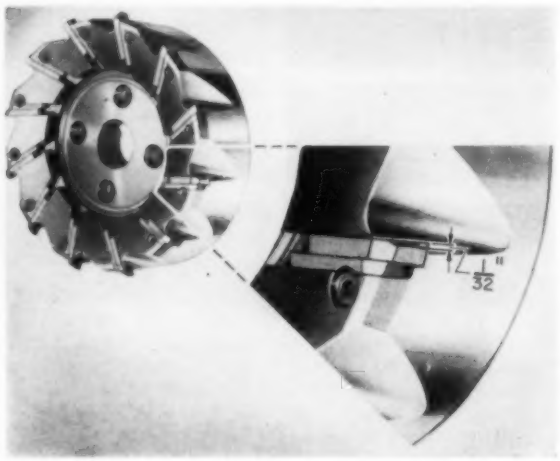

Fig. 18. Facemill cutter with carbide blades. In the enlarged section peripheral wear similar to that illustrated in Figs. 16 and 17 is shown. Specifically, 1/32-in. peripheral wear is indicated at which point the cutter should be resharpened.

1055, 3140, 4335 and NE 8745 steel, all heat-treated to about the same hardness of 300 Bhn. After the 9th pass the peripheral wear was usually $\frac{1}{32}$-in. wide. At this time a carbide cutter should be reground, since further wear occurs more rapidly and frequently entails breakage of the carbide tip. In testing the same materials, but of 200 Bhn, under identical conditions, it was possible to make an average of about 14 passes before the wear on the periphery of the cutter had reached a $\frac{1}{32}$-in. width.

When these materials were heat-treated to around 400 Bhn and tested with identical cutters and also the same feeds and speeds, hardly one pass was completed before failure due to fracture. Only by reducing the cutting speed to 130 fpm and the feed to 0.0045 ipt was it possible to extend cutter life. See Fig. 17. Chipping of the carbide blade still occurred occasionally, but this condition could have been improved by changing the grade of carbide. For these harder materials a tough and more shock-resistant grade of carbide would have given better results than the general purpose steel-cutting grade which was used.

Harder materials demand higher requirements of rigidity in the machine and workpiece set-up itself. These factors taken together make necessary a engineering attitude towards almost every new production set-up until a point has been reached at which optimum tool life and production, and thus lowest cost, have been reached.

The following points regarding temperatures in machining operations should be considered:

1. The tool-tip temperature is the most important temperature value in the complex thermal state of a metal-cutting operation.

2. With an increase in cutting speed, tool-tip temperatures increase and workpiece surface temperatures, after machining, decrease.

3. With an increase in feed, tool-tip temperatures increase and workpiece surface temperatures, after machining, decrease.

4. Workpiece surface temperatures, after machining, average chip temperatures and tool temperatures all increase with an increasingly negative rake angle.

5. After a certain time of operation, tool wear will bring about larger cutting forces, which involve greater power consumption and also higher temperatures in tool and workpiece.

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Pneumatic and Hydraulic Drives

Part 1

By John C. Hanna

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HYDRAULICS AND pneumatics are not only very important industrial applications of the past but are destined to be of even more vital concern in the future. The development of applications has been at an accelerating pace and there seems to be little doubt that this acceleration is to continue. As can be substantiated by looking back twenty years, industrial hydraulics and pneumatics today enjoy a greater proportionate use in all machinery than was the case two decades ago.

Dollarwise, industrial hydraulics comprises less than half of the entire field of hydraulics. Furthermore, the vast majority of industrial applications calls for pump hydraulics, which will not be discussed here.

Selecting a Drive

Usually hydraulics and pneumatics are not competitive. They are so dissimilar that there are few problems of selection between them which cannot readily be resolved, all factors considered, with a clear preponderance in favor of one or the other. Because one of the two sources of power is not readily available, compressed air is used where hydraulics might be better adapted, and vice versa. Certainly availability is one of the important factors of selection.

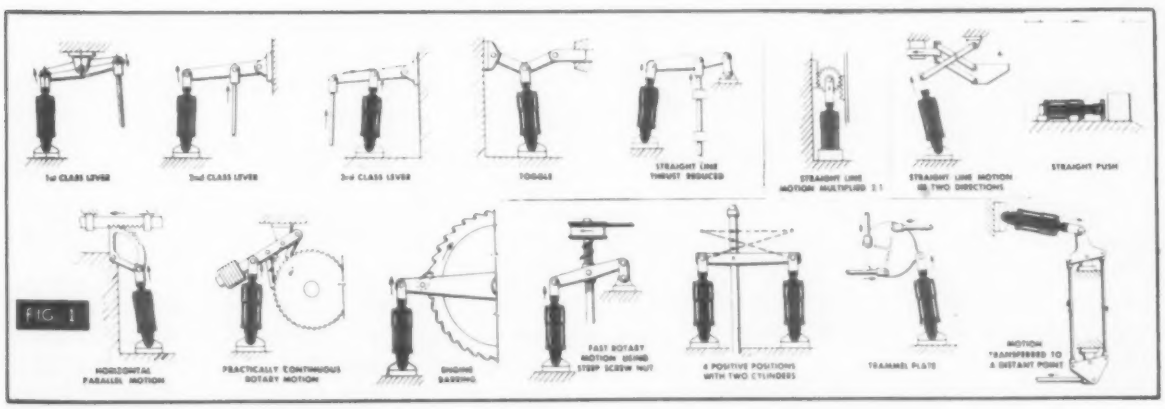
The two are often used in combination in one circuit, or as parts of the same machine or process. A description and analysis of a number of single-element and combination circuits (air or other gas used with oil or water) will serve to illustrate where and under what circumstances each is best called upon to function.

Fundamental Mechanisms. Figure 1 illustrates 15 fundamental mechanisms of a multitude of possibilities, by which cylinders may be used to transmit power. With the accompanying captions, most of the applications are self-explanatory.

D illustrates the use of fluid in an economical manner. This basic movement will be enlarged upon later. *K* is interesting in that both the forward and return piston stroke result in only a clockwise movement of the ratchet wheel. *N* shows four definite positions of the actuated member obtained by use of two cylinders. All of the movements illustrated in this figure may be obtained by simple applications of standard single or double-acting cylinders.

Presented at the 20th Annual Meeting of American Society of Tool Engineers, March, 1952.

Fig. 1. Applications of cylinders to provide fundamental mechanical motions.



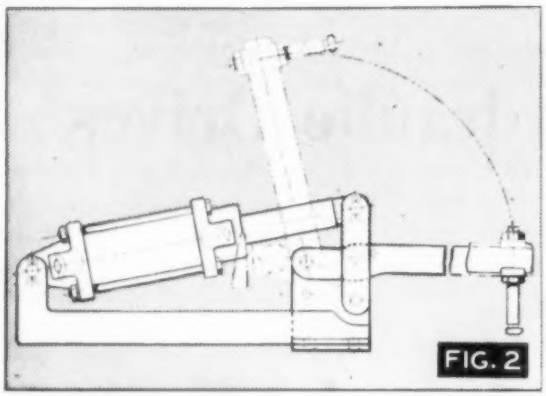


Fig. 2. Air-actuated toggle clamp.

Design and Cost. The tool engineer is faced with more than merely designing devices to meet manufacturing requirements. He is often called upon to design tools quickly, for comparatively short runs, and within a limited budget. In the application of any form of power, he should consider the cost per unit of energy. This consideration becomes a major or minor one depending on how much energy is used over the period that the machinery in question will presumably function before it becomes obsolete.

Generally speaking, compressed air is one of the more expensive sources of energy. This is true because, at the pressures ordinarily used in the shop, compressed air has lost important quantities of heat in the process of being compressed. Quite apart from the heat and pressure lost in exhausting waste air, there is also a loss of heat and pressure in the

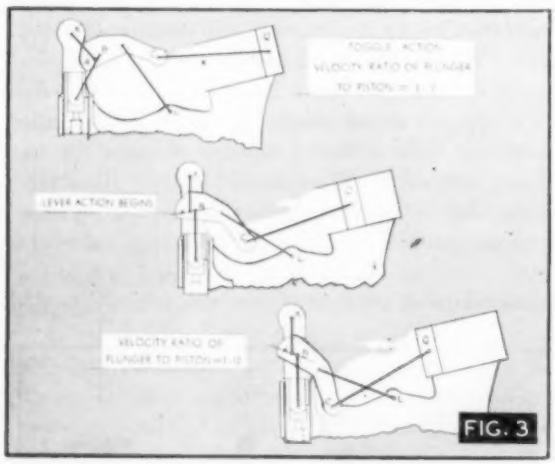


Fig. 3. Combination of toggles, guide link, and Class 2 lever.

process of being used. There is an old rule of thumb, which has been used repeatedly over the past 40 years, that compressed air costs five times as much as electrical power as most commonly used in an induction motor.

Here are some dollar and cents figures which may give some indication of the comparative cost between electricity and compressed air as sources of power. Assume that:

(a) Electricity costs two cents per kwh at the electric motor driving the compressor

(b) Five cubic feet of free air are compressed to seven atmospheres per hp of the electric motor

(c) Air is used usefully at near line pressure and also is expanded usefully down to near atmospheric pressure

(d) There is no electrical loss beyond 90 percent efficiency of electric motor.

With these assumptions, air will cost 0.5 cents for

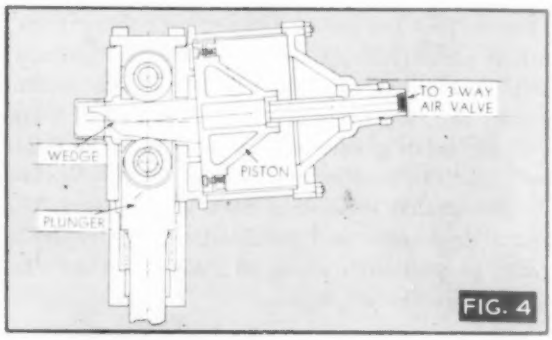


Fig. 4. Roller wedge mechanism for actuating a plunger.

each 100 cubic feet of free air. Compressed air will cost about 3-¼ times as much as electricity. However, air is not frequently used economically according to assumption (c). Therefore, the old rule of thumb of five to one is not a bad approximation.

Perhaps the comparison between compressed air energy and oil hydraulic energy would be oversimplified by applying an 80-percent pump efficiency factor to the previous figures, but this more or less arbitrary efficiency would indicate that compressed air is 2.6 times as costly as oil hydraulics. This latter comparison was made on the assumption that an important part of hydraulics today is saddled with the loss in use which is inherent in the accumulator. If there is no accumulator in the system, air might well cost four times as much as hydraulic energy.

The comparisons just drawn lead perhaps to surprise at the tremendous amount of compressed air used throughout industry and particularly in the shop. The answer, of course, lies in the versatility of air, the simplicity of its application and the fact that air in many instances is not used in really large quantities.

One of the great virtues of compressed air is its economy as stand-by energy. Once the compressed air has arrived in the shop line system, it stands by at no cost (the costs given above include all losses

to this point). Usually an electric motor runs while standing by and this cost cannot be ignored. The fact remains that air should be used frugally.

Using Air Economically. There is poor economy in using an air cylinder for a long stroke wherein only a small portion of the stroke—for instance, at its end, or its beginning—is usefully employed. An example is the clamping cylinder with a long stroke to clear surrounding interferences. In the reverse action, an example would be the case where high pressure is used at the beginning of the stroke for breakaway force, followed by a long clearance stroke. In this latter case, air energy can be conserved by not allowing air pressure to build up at the end of the clearance stroke.

A good example of the economical use of air is the air-actuated toggle clamp shown in Fig. 2. Here the clamp arm moves through its entire stroke in a rapid circular movement for most of the stroke,

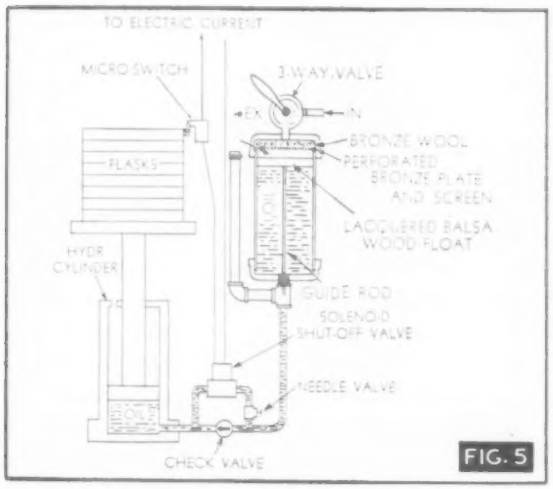


Fig. 5. Automatic positive positioning of work on table.

under a comparatively small force, and then a decreasing velocity and an increasing force is realized as the clamp approaches the work.

Another good example is found in the mechanism in Fig. 3, consisting of a combination of toggles, a guide link and a simple Class Two lever. For the first ½ in. of the stroke, the ratio of plunger to piston movement is about 3:2, whereas at the last half of the piston stroke, the plunger moves at a leverage of 1/12 as fast as the piston.

The movement of the plunger in Fig. 3 is very closely duplicated by the roller wedge mechanism pictured in Fig. 4.

Positive Positioning of Load through Oil, Air and Electricity. In Fig. 5, the source of power is compressed air which acts upon the oil in the reservoir. The guided balsa wood float serves to prevent mixing of the air and oil when sudden surges of either medium take place. In addition, the bronze wool and perforated screen near the air intake disperse the inward jets of air.

The cylinder is directly actuated by oil which is forced through a check valve to lift the table. Opening the reservoir to exhaust stops movement since the check valve traps oil in the cylinder. Use of oil provides a smooth positive movement unattainable with a gas.

Automatic positioning maintains a constant level at the top of the stacked parts. This is accomplished by employing a solenoid valve that is closed except when energized through the micro-switch. The micro-switch is closed by the stacking of another part, thus opening the solenoid valve. In series with the solenoid valve is a needle valve which simply controls the ram velocity downward. This type of circuit might very well handle the stacking of parts as they are fed from a machine or a conveyor line.

Meeting the High Pull-Out Problem. If smooth control is required for a cycle in which the initial resistance is very high followed by a sudden release (such as is encountered in drawing a pattern from a mold), a circuit such as that shown in Fig. 6 may be desirable. Speed is regulated by using an air-actuated and oil-controlled cylinder. The exhaust oil passes through a needle valve until the initial break-away force is overcome. When this force has been overcome without jolting of the members involved, the extended piston rod contacts a micro-switch, opening the bypass valve and allowing rapid

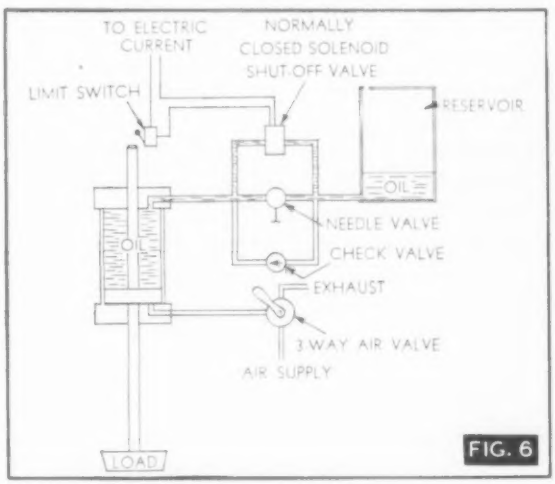


Fig. 6. Mechanism for providing high pull-out force with sudden release.

travel for the remainder of the stroke. Conservation of air dictates that the air pressure should not be allowed to build up at the end of the stroke. This calls for a shut-off of the air supply near the top of the piston stroke. The mechanism is gravity returned.

(Continued next month)

Heat-Treating and Machining of Boron Steels

Part II

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THE RELATION between carbon content and ability of boron treatment to increase hardenability has been cited above. This relation is recognized, but its specific effect on carburized work is still somewhat controversial. Many variables contribute to interpretation of tests, and the results observed have been scattered. Research has established that this relation between carbon content and hardenability effect (Grossman multiplying factor) of boron is linear, at least up to carbon of about 0.90 percent. This is shown graphically in Fig. 5 in which results of several investigations have been plotted by Raher and Armstrong. The following formula expresses this relation:

$$F_b = 1 + 1.5\ (.9\text{-}C)$$

in which F_b = multiplying factor for boron treatment

C = carbon content in percent

In the medium carbon grades this is relatively unimportant since this factor is included in the hardenability information on the basis on which the steels are selected. It is of major importance, however, in considering the carburizing grades.

Opinion differs on the required hardness of carburized parts. The surface must, of course, be hard, although reduced surface hardness, if due to austenite retention, may be satisfactory or even desirable. Core hardness, however, is controversial as shown by the wide range of automotive practice. The core must have sufficient strength to properly support the case, and should be soft enough to avoid the high residual tensile stresses often resulting from extreme core hardness.

The relation between carbon content and boron effect results in the boron carburizing steels exhibiting excellent hardenability of the core, but questionable properties in the outer region of the case. This has resulted in widespread reports that boron steels are subject to excessive distortion, and a few instances where surface hardness could not be met.

Core hardness can be quite satisfactorily handled by care in selection of carbon content. Use of a carbon range of 0.13 to 0.18 percent has, in most cases, been quite successful in reducing core hardness to normal levels and in reducing distortion to the level of previous steels used. Dimensional changes are sometimes different, the principal result being greater shrinkage of internal openings such as bores of gears, but these changes can be allowed for in machining. Pilot runs should be made to determine any necessary modification of green dimensions (dimensions prior to heat-treating).

Case hardness is a more difficult problem. Figs. 6 and 7 show Jominy hardenability of two steels, 4118 and 41B18, of similar analysis except for boron treatment. Hardenability curves were made at the surface and also at various depths below the surface, representing different carbon contents. At the surface of the boron-treated sample (carbon 0.95 percent) no increase in hardenability results from the boron, as shown by comparison with the

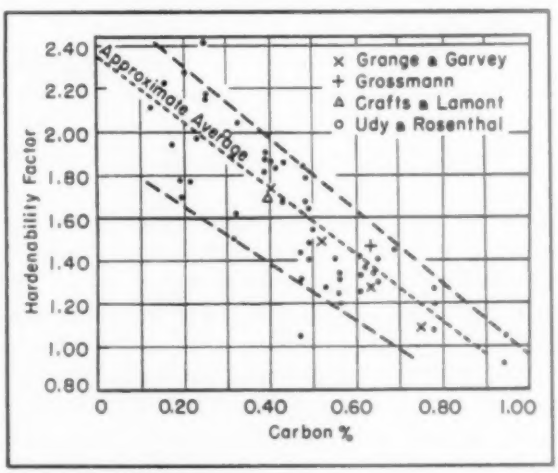

Fig. 5. Relation between carbon content and the hardenability effect of boron.

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4118 sample. At carbon concentration of 0.85 percent and lower, definite effect of the boron treatment is evident.

Fig. 8 shows the result of the comparison of four pairs of steels, each pair containing a conventional carburizing steel and the same heat or a similar heat boron-treated. Ideal diameter (D_I) has been calculated from the Jominy curves at various carbon levels of the case. The chart shows the effect of boron on hardenability at 0.90, 0.80 and 0.70 percent carbon. These results follow the same pattern as the previous example.

Heat-treatment can be modified to improve surface hardness somewhat. In spite of the formula discussed above, experience has shown that boron does give considerable boost to hardenability up to

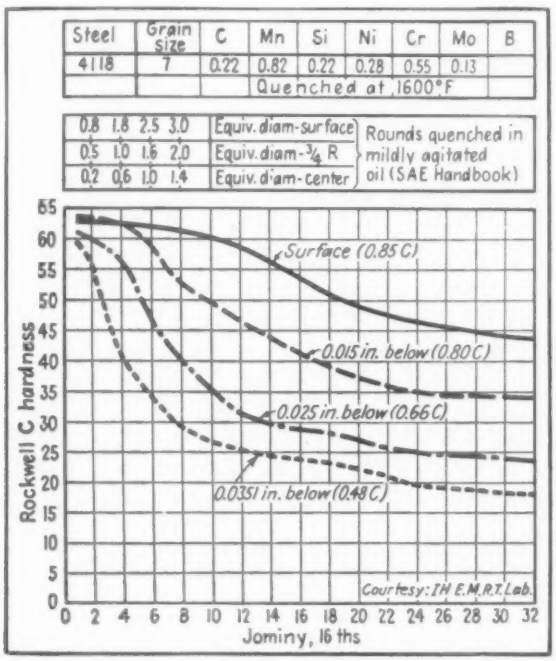

Fig. 6. Jominy hardenability curves for 4118 steel made at the surface and at various depths below the surface.

about 0.85 percent carbon and it is possible to control carburizing conditions to avoid higher carbon content.

Actually, many alloy carburized parts are made from steel far richer in hardenability than is necessary. Steps taken in material specifications on a small tractor ring gear and pinion are shown in Table III. Parts involved are spiral bevel gears of 6.314 diametral pitch. The result of shortages, first

TABLE III—MATERIAL USED ON TRANSMISSION GEAR

GRADE	ALLOYS PRESENT			B	REL. HARDENABILITY	
					CASE	CORE
8615	Ni	Mo	Cr	NO	1.0	1.0
4118	—	Mo	Cr	NO	0.7	0.7
50B15	—	—	Cr	YES	0.6	1.2
5014	—	—	Cr	NO	0.6	0.6

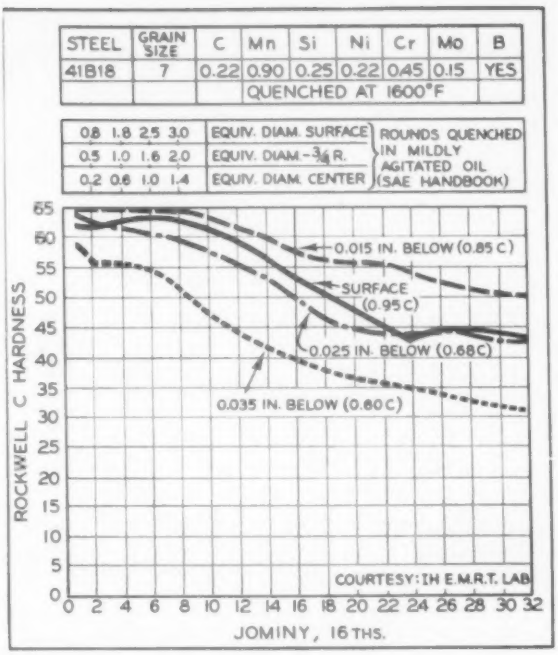

Fig. 7. Jominy hardenability curves for 41B18 steel show the effects of boron treatment. This is evident as the carbon concentration decreases.

of nickel and then of molybdenum are indicated. The grade shown as 5014 is the same as 50B15 steel except that no boron is used. This material was finally specified, since sufficient hardenability was present without boron. Hardenability of both case and core is shown related to that of 8620 steel as 1.0. (These are relative, not absolute values.) Obviously, the hardenability of 8620 steel was not required on this part in the first place. Note the high hardenability of the core of 50B15 steel. Excessive core hardness was avoided by specifying low carbon content.

This last step from 50B15 to 5014 steel is typical of the present trend in the automotive group. Consideration is being given to providing low alloy carburizing steels without boron that are within the ranges of alloying elements permitted by the National Production Authority and which have sufficient hardenability for many applications. For heavier carburized parts, the higher alloyed boron steels such as 94B17, 86B20 and others are being successfully used with consideration for the factors discussed above.

Machining of Boron Steels

Very little has been reported on the problems of machining boron steel. A few sources have reported increased machinability, but in general very little difference exists between these steels and those they replace as far as machining is concerned. Steel is machined in three basic conditions—as rolled, as normalized or annealed (with or without forging) and after quench and draw.

In the as-rolled and normalized or annealed state,

hardness and microstructure are very important factors since a great deal of steel is machined in this condition. Addition of conventional alloying elements to steel lowers the temperature at which pearlite forms, resulting in higher hardness on slow

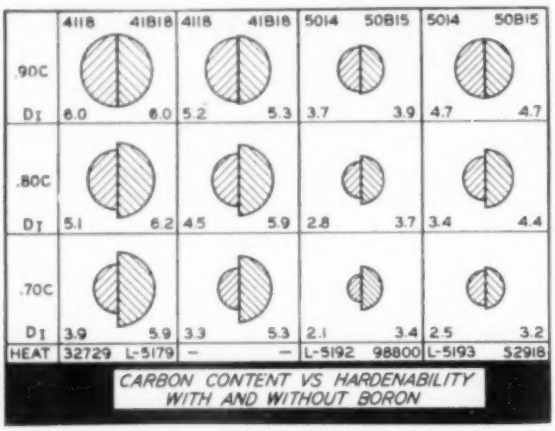

Fig. 8. Hardness comparisons for four pairs of steels, one conventionally carburized, the other of the same or similar heat but boron treated.

cooling, such as from the rolling operation or from the normalizing furnace. This effect is not produced by boron treatment with the result that as-rolled and normalized hardness levels are usually somewhat lower with the boron steels than with the materials they replace. This is true of boron additions to plain carbon steels and to low-carbon low-alloy steels. Some increase in normalized and as-rolled hardness of higher hardenability materials may result from boron treatment. In general the effect is minor and little difference in machining is noted.

An exception to this is the reduction in carbon content frequently specified in substituting a boron carburizing steel. In this case, considerable drop in normalized or annealed hardness may occur and poor finish and tool trouble may be encountered. A typical example is a small gear with an involute spline bore. Substitution of 50B15 for 8622 steel resulted in rough finish in the root of the spline and poor broach life. Increasing the back rake or hook of the broach and changing from a water-base soluble oil to a sulphurized cutting oil restored normal finish and tool life.

Medium carbon boron steels quenched and drawn are no different to machine than the materials they replace. Scattered reports of a slight increase in ease of machining may be due in some way to the reduced alloy content, but are more likely due to the fact that these materials were closely watched and carefully processed. Improper heat-treatment of any steel may result in structures that impair machinability.

Sulphite treatment for improved machinability may be used with boron steels. Large quantities of 50B44 steel (sulphite-treated) are in use and improvement in machinability is comparable to that obtained with 8641 steel.

Acknowledgements

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Broaching of Internal Gears

(Continued from page 48)

An increase in production to 5000 units was contemplated, and later realized, necessitating the purchase of additional machine tools such as 1 dual puller broaching machine, 28 gear shapers, and 4 gear shaving machines.

The operation sequence for making the internal gear teeth was (a) rough broach, (b) semi-finish gear shape, and (c) finish gear shave. The operation sequence proposed by the broaching method was (a) rough broach, and (b) finish broach.

Purchase of the additional machine tools was held up pending the favorable outcome of an experimental program to determine if the tolerances of 0.0003 in. on involute and 0.0005 in. on the lead of the helical internal gear could be held.

The production of 5000 units was maintained with some slight over capacity, using 2 dual puller broaching machines for the roughing operation and 3 small push broaching machines for the finishing operation. This is as compared to 56 gear shapers and 8 gear shavers.

In addition to a direct savings of machine capital must be added the savings in floor space, together with savings in machine operating labor, power, machine maintenance labor, machine parts and tool sharpening labor and equipment.

In addition to these savings, tool costs were reduced. The rough broaching, gear shaping, and gear shaving operation required an outlay of 16 cents for tools while the rough and finish broach cost averaged 6 cents. This adds up to direct savings of $250,000.00 on 2,500,000 gears produced by the broaching method during the past three years.

An Analysis of Cost Estimating Principles and Practices

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Part IV

SUPPOSE THAT the estimates of all the jobs made in a plant during a year are totalled and then their sum is found to agree with the total of the actual costs. On that basis alone the estimating practice might be considered perfect, but that is not the whole story. Each estimate no doubt differed one way or another from actual cost, and each individual difference represented a real or potential business loss. An estimate that differs greatly from actual cost is commonly recognized as undesirable, even though a number of such estimates may average the same as the actual costs.

Under the circumstances depicted in Fig. 8, the jobs estimated low were quoted and sold below prices necessary to recover costs and make a reasonable profit. Although the high estimates made up for the low ones as far as current solvency is concerned, they have created a chance for loss. In times of prosperity customers may have to pay excessive prices for their needs, but at least some realize they are being overcharged and the vendor suffers a loss of good will.

A study like that reflected in Fig. 8 cannot reveal the errors that might have been present in estimates that have not materialized into orders. Such jobs are not made, and their true costs do not become known. It may be that the unsold estimates have a still greater leaning towards the high side. In times when business is not active and competition is keen, the majority of lost business may be accounted for by high estimates. In the long run, a serious loss of business can be expected from high estimates, and the amount of this loss is related to the spread of the deviations of the high estimates from actual costs.

As stated before, tool estimates are made in some plants to ascertain fair prices to pay to have the tools made outside. Obviously a high estimate under such circumstances leads the buyer to pay more than he should for the tool. On the other hand, it may be difficult, if not impossible, to get a supplier to furnish a tool at an underestimated price. Product estimates are sometimes made to decide whether to make or buy an article. Again if the estimate is high, it may be conducive to buying the article for more than it should have to cost.

As a given estimating practice becomes more efficient, the spread of the errors in the estimate is reduced. The probable error of any one job is likewise reduced. The losses from both low and high estimates decrease. The probable error of any one case can be reduced by increasing the number of elements estimated. This is depicted by the curve Q_1 in Fig. 9.

All jobs could be estimated with very little chance of loss by breaking them down into many elements, but the cost of making the estimates would then become prohibitive. The more detailed an estimate, the more expensive it is. The cost of making an estimate results from the time needed to analyze the job, the time to study and evaluate each element, and the cost of compiling data for reference. These

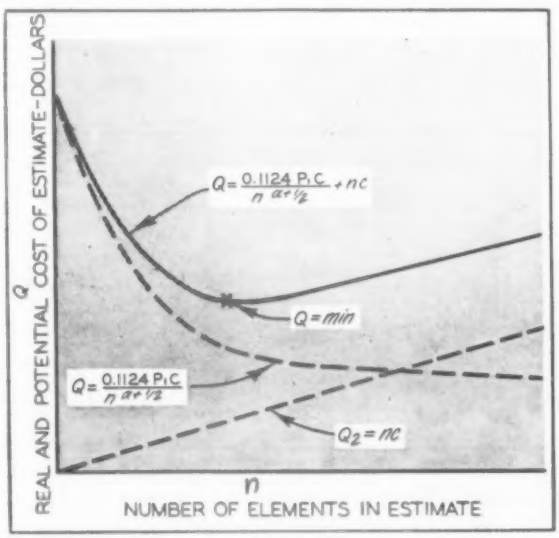

Fig. 9. Effect of the number of elements upon the real and potential cost of an estimate.

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costs increase in some proportion with the number of elements involved in an estimate. This increase is simulated by the straight line Q_2 of Fig. 9 that rises at a uniform rate as the number of elements increases.

The total real and potential cost inherent in any estimate is the sum of the cost of making the estimate plus the real and potential loss resulting from the error of the estimate. This total cost is represented by the curve Q in Fig. 9 which decreases for small values of n. After reaching a minimum point, the curve Q rises. The number of elements that bring about the minimum real and potential cost of an estimate is the optimum number into which a project should be divided. This is a different number for almost every case, and certainly is not a practicable point to try to find exactly for any actual job. When a project is estimated, it is broken down to a certain stage, as previously explained. That stage is selected which is judged to provide the number of elements that will result in approximately the lowest total real and potential estimating cost.

A Theory of Cost Estimating Procedure

A project can be estimated most efficiently when it is divided into a suitable number of elements. But what is the right number? General principles to guide the estimator may be deduced by making several simplifying assumptions.

A project is to be estimated by dividing it into n equal elements. When elements of this order are estimated, the distribution of their percentage deviations from actual cost is normal with a spread

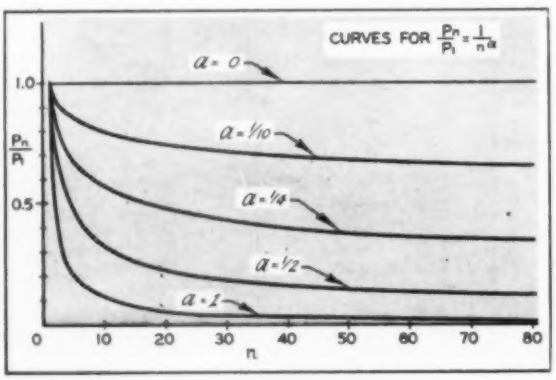

Fig. 10. Typical curves for $P_n/P_1 = 1/n^a$ for several values of a.

P_n corresponding to $\pm$ 3σ limits. This is an ideal situation that is only approximated even by the best estimating practices. Practically all the percentage deviations fall within the range P_n. If $n = a$, then P_n has a value P_a; if $n = b$, P_n has a different value, P_b. The errors in the estimates occur from chance causes and therefore at random.

The sum of the n elemental estimates is the estimate of the total cost of the project. Practically all the percentage deviations from actual costs of projects estimated in the way described fall within a range P_s. A fundamental theorem of statistics specifies that

$$P_s = \frac{P_n}{\sqrt{n}} \qquad (1)$$

Thus, the spread of the percentage errors of projects of the kind under consideration is less than the spread of percentage errors of the elements. If P_n remains the same or decreases, P_s decreases as n increases.

As previously discussed, small and simple elements are easier to estimate than large and complex elements. As a project is divided into more and more elements, its elements become smaller and simpler. With the same effort applied to estimating all elements, small elements can be estimated more accurately than large ones. That means that P_n decreases as n increases. Such a trend can be depicted in a general way by the relationship that

$$P_n = \frac{P_1}{n^a} \qquad (2)$$

where P_1 is the spread of the distribution of percentage errors when $n = 1$; that is when the projects are estimated on an overall basis. The exponent a may be selected to approximate various rates of decline of P_n with increase of n.

The curves in Fig. 10 are typical of the relationship between the ratio P_n/P_1 and n of equation (2) for several values of a. When $n = 1$, P_n always equals P_1. For $a = 0$, $P_n = P_1$ for all values of n. This is a limiting case when no improvement in the accuracy of estimating elements results as the elements become smaller. For any value of $a > 0$, the ratio P_n/P_1 approaches but never reaches zero as n increases to infinity. For $a = \frac{1}{2}$, the decline of the curve is rapid for small values of n, more so than appears likely in most practical cases. Therefore, a value of $a = \frac{1}{2}$ seems to be about the largest that reflects most actual experience. It would appear that most cases would be approximated by a value for a somewhere between 0 and $\frac{1}{2}$.

From equations (1) and (2)

$$P_s = \frac{P_1}{n^{a + \frac{1}{2}}} \qquad (3)$$

The term P_s is equal to 6 times the standard deviation of the normal distribution of errors in estimates of the total cost. The probable percentage error, high or low, in total cost of the project is 0.6745σ. This is the percentage error that is as likely to be exceeded as not on either the high or low side, and is designated by

$$P' = 0.1124\, P_s = \frac{0.1124 P_1}{n^{a + \frac{1}{2}}} \qquad (4)$$

The real and potential loss suffered from the error in estimating a project of this type is assumed the

same as the difference between the estimated and actual cost. If C is the actual value of the project, the probable real and potential loss is

$$Q_1 = CP' = \frac{0.1124\, P_1\, C}{n^{a + \frac{1}{2}}} \qquad (5)$$

A straight line function expressing a proportional rise of the cost of making the estimate as n increases is nc, where c is the average cost of estimating any element. This is the straight line Q_2 in Fig. 9.

The total real and potential cost of the estimate is then

$$Q = \frac{0.1124\, P_1 C}{n^{a + \frac{1}{2}}} + nc \qquad (6)$$

A typical curve for this relationship is shown in Fig. 9.

The value of n for Q_{min} is found by setting the derivative of equation (6) equal to zero and solving for n. Thus

$$\frac{dQ}{dn} = -(a + \tfrac{1}{2})\, \frac{0.1124\, P_1 C}{n^{a + \frac{3}{2}}} + c = 0$$

$$\text{and } n_{min} = \left[\frac{0.1124\ (a + \tfrac{1}{2})\ P_1 C}{c}\right]^{\frac{2}{3 + 2a}} \qquad (7)$$

for $a = 0$

$$n_{m0} = 0.147 \left(\frac{P_1 C}{c}\right)^{\frac{2}{3}} \qquad (8)$$

$$\text{and} \qquad Q_{m0} = 0.44\, (P_1 C)^{\frac{2}{3}}\, c^{\frac{1}{3}} \qquad (9)$$

for $a = \tfrac{1}{2}$

$$n_{m\frac{1}{2}} = 0.336 \left(\frac{P_1 C}{c}\right)^{\frac{1}{2}} \qquad (10)$$

$$\text{and} \qquad Q_{m\frac{1}{2}} = 0.67\, (P_1 C_c)^{\frac{1}{2}} \qquad (11)$$

Fig. 11 shows curves of the variable $\frac{P_1 C}{c}$ plotted against n for $a = 0$ and $a = \tfrac{1}{2}$.

Guides to Efficient Estimating Procedure

The theory just developed is based upon ideal conditions that obviously are never fully realized in practice. It assumes, in short, that the principles that have been discussed have been observed to the fullest possible extent; that all but pure chance causes of errors are eliminated in every case. That is not the situation if estimating practice is poor and haphazard. However, conscientious and competent estimating practice approaches the ideal conditions. Certain general principles can be deduced from the theory and help to define the limits of good estimating practice.

Uniform Estimating Practice Can Be Economical

A curve like that typified in Fig. 9 for equation (6) is fairly flat for a wide range of values of n on both sides of the minimum. As an example, when $a = \tfrac{1}{2}$, the total real and potential cost of estimating is not more than 10 percent above the minimum over a range equal to about 90 percent of the number of elements that gives the minimum cost. If in a particular situation, the theoretical minimum cost of estimating is obtained when a job is divided into 20 elements, the cost should be no more than 10 percent above the minimum if the job is divided into any number from 13 to 31 elements. If the optimum number of elements is 2000 for another job, any number of elements from about 1300 to 3100 will not increase the estimating cost more than 10 percent. Furthermore, the smaller that a is, the larger the choice of the number of elements becomes. When $a = 0$, the range for n over which the cost of estimating does not increase more than 10 percent is about $1\tfrac{1}{2}$ times the range when $a = \tfrac{1}{2}$.

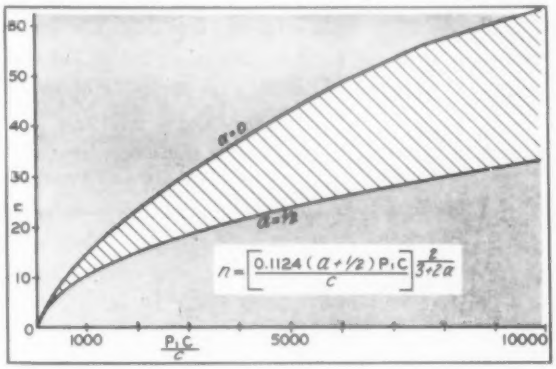

Fig. 11. Theoretical numbers of elements desirable for estimating various projects.

Departures in practice from the simplifying assumptions of the theory have an effect similar to decreasing the value of exponent a in equation (6). That effect is favorable because the selection of the number of elements is thereby increased.

The theory indicates that a project may be divided as convenient into any number of elements within a wide range. That supports conventional estimating practice where a certain procedure is established for estimating all jobs of a particular class. Each job is broken down into elements at a particular stage. The number of parts and the number of elements vary from one job to another. Even so, a variety of jobs in one class are served quite well by the uniform procedure. The theoretical lowest estimating cost is likely to be realized in only a few cases, but otherwise the results are economical for all practical purposes.

The Economical Number of Elements for an Estimate

The number of elements into which a project or class of projects should be divided depends theoretically upon an exponent a and a factor $\left(\frac{P_1 C}{c}\right)$ as expressed in equation (7). That relationship may be visualized as a surface that cuts two planes normal to an a axis perpendicular to the paper in

Fig. 11. The planes are $a = 0$ and $a = \frac{1}{2}$, and the intersections are indicated by the curves. The shaded area between the curves is a projection of the surface between the planes.

The path of a curve on the surface representing equation (7) is determined by the estimating procedure. Such a curve has a projection on the plane in Fig. 11 within the shaded area and a trend between the curves for $a = 0$ and $a = \frac{1}{2}$. For an established procedure, the optimum number of elements, n, in any applicable case depends upon the factor $\left(\frac{P_1 C}{c}\right)$.

The factor P_1 designates the difference between the highest and lowest percentage error that may occur if a project is estimated on an overall basis. If a project can be compared with a recent identical job, P_1 may be very small, and a value of $n = 1$ justified. If doubts exist about an overall comparison, the indication is that P_1 is large and the project should be divided into a number of elements. In general, a probability of large errors at any stage of estimating calls for a more detailed breakdown.

The term C stands for the total cost of a project. A production job with a risk of many thousands of dollars warrants a more detailed breakdown than one worth a few hundred dollars if other considerations are approximately the same. However, the difference in the number of elements for two such jobs is numerically only a fraction of the difference in values. For example, a device made as a special item costs $300. If 100 are to be produced, the unit cost is $100, and the total cost of the lot is $10,000. The amount of money risked in producing the lot is 33 1/3 times that involved for the special item, but the production estimate may require no more than about 10 times as many elements as the estimate for the single device for comparable efficiency.

A pertinent observation at this time is that each successive stage in estimating, as suggested in Fig. 3, is associated with a multiple increase in elements. This can be seen in a simple case of the labor to make a device consisting of five parts. Assume that an average of 6 operations are needed to make each part. If the cost of each operation is estimated, 30 elements constitute the total labor cost. If each operation is divided into 5 elements at the next stage, the total number of elements becomes 150. An estimate for a project may consist of 25 elements at Stage V, 100 elements at Stage VI, and 500 elements at Stage VII. Modifications may be made in an estimating procedure to meet specific situations, but in general each typical stage is best suited to projects in certain cost ranges. In other words, if a job is efficiently estimated at Stage VI, it is not likely to be estimated economically at either Stages V or VII.

Projects of the same class may differ considerably in cost but be efficiently estimated at the same stage because the more costly has many parts and the less expensive has few parts. A complex special machine tool may have several hundred parts, an ordinary fixture 10 or 20 parts. That is the difference between the projects estimated at approximately the same stage and illustrated in Figs. 1 and 2. The special machine tool estimate of around $20,000 should be derived from 10 or more times as many elements as the tool estimate of $715. That requirement is fulfilled by the proportionately larger number of parts in the costly machine tool.

The influence of the cost and nature of a project upon the desirable stage for estimating its cost was pointed out in describing the procedure associated with Fig. 4A. When one or a few articles of a kind are estimated, the breakdown is of the order of Stage VI (Fig. 3). When 1000 pieces or more of the same kind make up a project, but only one piece can serve as the basis for the estimate, the operations are broken down into their elements. Thus, the latter procedure approaches Stage VII (Fig. 3) in order to increase the total number of estimates on which to base the estimate.

Unit Cost of Estimating Elements

The term c stands for the average direct cost of estimating each element. If the cost of estimating each element is large, the number of elements should be small to keep down direct estimating expense. Such a situation may exist where estimates of a certain kind are made infrequently and the collection of data for extensive estimates would be uneconomical. On the other hand, where a sufficient volume of estimating exists, the standardization and tabulation of basic data make it possible to decrease the cost of estimating each element, to resort to larger numbers of elements, and in the long run to minimize the total real and potential cost of estimating.

Table I and Figs. 7A and B are two examples of tables of basic data for estimating purposes. Tables like these are costly to compile but do help to reduce the time needed to make each estimate, are conducive to accurate results, and make it possible to use a lower order of skill on some of the estimating work. Such tables can never replace competent and skilled estimators entirely, but they do fit into routines where much of the work can be assigned to clerks under the supervision of the estimator.

Acknowledgments

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American Standard Tolerances for Ball and Roller Bearings

(Conclusion)

Table 15—Tapered Roller Bearings Tolerances in Inches

Cone Bore in Inches	Cone Bore Tolerance				
	Class				
	4	2	3	0	4B
Up to 2½ inclusive	+0.0005 −0.000	+0.0005 −0.000	+0.0005 −0.000	+0.0005 −0.000	+0.0005 −0.000
Over 2½ to 12 inclusive	+0.001 −0.000	+0.001 −0.000	+0.0005 −0.000	+0.0005 −0.000	+0.001 −0.000
Over 12 to 24 inclusive	+0.002 −0.000	....	+0.001 −0.000	....	+0.002 −0.000

Cup Outside Diameter in Inches	Cup Outside Diameter Tolerance				
	Class				
	4	2	3	0	4B
Up to 12 inclusive	+0.001 −0.000	+0.001 −0.000	+0.0005 −0.000	+0.0005 −0.000	+0.001 −0.000
Over 12 to 24 inclusive	+0.002 −0.000	....	+0.001 −0.000	....	+0.002 −0.000
Over 24 to 36 inclusive	+0.003 −0.000	....	+0.0015 −0.000	....	+0.003 −0.000

Class	Maximum Cup Outside Diameter
4	All sizes
2	12 inches
3	All sizes
0	12 inches
4B	All sizes

Overall Bearing Width Tolerances

For TSF* bearings the tolerance applies to the dimension from the back face of the cup flange to the back face of the cone

Bearing Type*	Class				
	4	2	3	0	4B
TS, TSF, TSS, and TST	See Note Marked †	+0.008 −0.000	+0.008 −0.008	+0.008 −0.008	+0.014 −0.010
TNA and TNAS (inclusive 5-inch bore)	+0.010 −0.000	+0.010 −0.000	+0.010 −0.000	....	+0.010 −0.000
TNA and TNAS (over 5-inch bore)	+0.030 −0.000	+0.030 −0.000	+0.030 −0.000	....	+0.030 −0.000
TDI, TDO, TDOS (inclusive 4-inch bore)	+0.016 −0.000	+0.016 −0.000	+0.016 −0.000	+0.016 −0.000	+0.016 −0.000
TDI, TDO, TDOS (4- to 6-inch bore)	+0.020 −0.000	+0.020 −0.000	+0.020 −0.000	+0.020 −0.000	+0.020 −0.000
TDI, TDO, TDOS (over 6-inch bore)	+0.030 −0.030	+0.030 −0.030	+0.030 −0.030	+0.030 −0.030	+0.030 −0.030

Maximum Radial Runout and Maximum Side Runout of Bearing Assembly

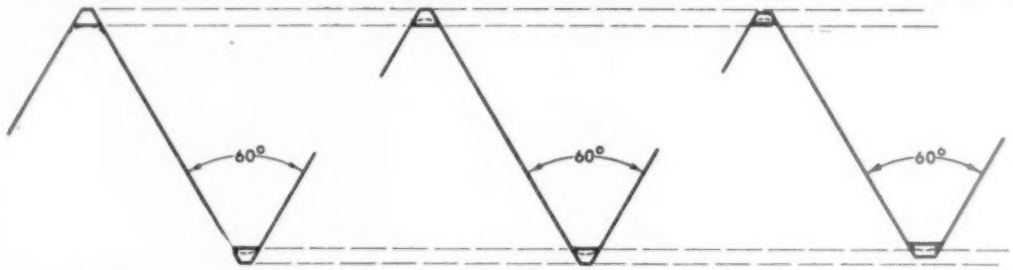
Bearing Outside Diameter in Inches	Class				
	4	2	3	0	4B
Up to 12 inclusive	0.002	0.0015	0.0003	0.00015	0.002
Over 12 to 24 inclusive	0.002	....	0.001	....	0.002
Over 24 to 36 inclusive	0.003	....	0.002	....	0.003

*AFBMA Designations.

†Over-all bearing width tolerance +0.008 inch, −0.000 inch for all assemblies in any one series having cone bores up to and including 4 inches. All others +0.014 inch, −0.010 inch. Radius tolerance +1/64 inch, −0.

—American Standards Association

Thread Form Specifications for External Taper Pipe Threads



NPT, NPTR, NPTC and NPTG
American Standard

ANPT
Aeronautical National Form

NPTF
American Standard (Dryseal)

The dotted radii show the permissible rounding due to worn tools. The radius at the crest of the NPT, NPTR, NPTC and NPTG thread may be outside of the truncation tolerance. However, the radii at the crests of the ANPT and NPTF threads and at the roots of all of these threads must be within the truncation tolerance.

Specifications for NPT, NPTR, NPTC or NPTG and ANPT Threads

Threads per inch	Pitch	Height Fundamen. Triangle**	*Truncation		*Width of Flat		Height of Thread	
			Max.	Min.	Max.	Min.	Max.	Min.
27	.0370	.0321	.0036	.0012	.0041	.0014	.0296	.0250
18	.0556	.0481	.0049	.0018	.0057	.0021	.0444	.0383
14	.0714	.0619	.0056	.0024	.0064	.0027	.0571	.0507
11½	.0870	.0753	.0063	.0029	.0073	.0033	.0696	.0626
8	.1250	.1083	.0078	.0041	.0090	.0048	.1000	.0928

*Dimensions given are for both crest and root.
**Height of Sharp V Thread.

Specifications for NPTF (Dryseal) Threads

Threads per inch	Truncation				Width of Flat				Height of Thread	
	Crest		Root		Crest		Root			
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
27	.0035	.0017	.0052	.0035	.0040	.0020	.0060	.0040	.0269	.0234
18	.0043	.0026	.0061	.0043	.0050	.0030	.0070	.0050	.0412	.0377
14	.0043	.0026	.0061	.0043	.0050	.0030	.0070	.0050	.0550	.0515
11½	.0052	.0035	.0078	.0052	.0060	.0040	.0090	.0060	.0666	.0623
8	.0069	.0052	.0095	.0069	.0080	.0060	.0110	.0080	.0962	.0919

—Courtesy Reed Rolled Thread Die Company

Gadgets

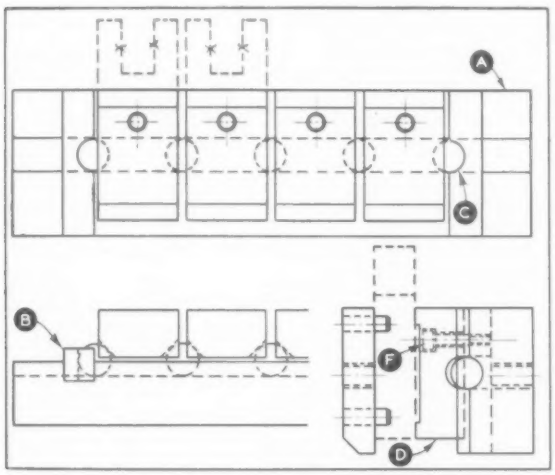
Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Automatically Adjustable Vise Jaws

For quantity production, it is sometimes advisable to set up a gang of cutters to mill a number of pieces at a time. The quickest method is to hold them with a vise with specially designed jaws to locate the workpieces. This is difficult when the thickness varies even slightly.

Th device shown here automatically adjusts the vise jaws to accommodate considerable variations. The stationary jaw locates and holds the pieces against the pressure of the movable jaws.

Main plate A has a circular groove cut into it longitudinally to hold a number of steel balls, one more than the number of workpieces to be machined. Two blocks B fit tightly into slots cut across the plate. These plates have a semi-circular cut C which acts as a stop for the first and last ball. Blocks D are relieved to touch the work in two places.



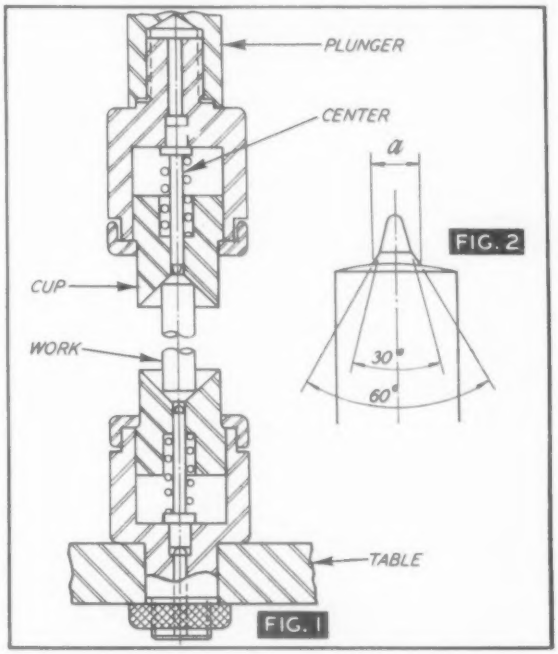
Semi-circular grooves are milled at each side of these blocks at an angle of 45 degrees. Each of these blocks is loosely suspended on screws F. The balls rest in the longitudinal groove and touch the two 45-deg grooves and the end groove C and transmit pressure to the workpieces. Any difference in thickness causes the balls to shift longitudinally and a pivotal motion of the blocks D transversely until all pressures are equalized. The rolling motion of the balls makes for sensitivity and the almost semi-circular contact reduces the pressure on the balls. The plate and blocks are made of heat-treated chrome molybdenum steel.

Robert Mery
Farmingdale, N. Y.

The Tool Engineer pays regular page rates for accepted contributions to these pages with a minimum of $5.00 for each item.

Centering Shafts

The device described here is used to center shafts of aluminum, aluminum alloys, free-cutting steel, mild steel, brass and bronze of 1/4 to 2 in. in diameter before machining. The centering is not done with center drills which often break, but with hardened tool steel centers of the desired shape driven into the work.



The device for centering shafts is shown at the left while at the right is a detail of the shape of the centers.

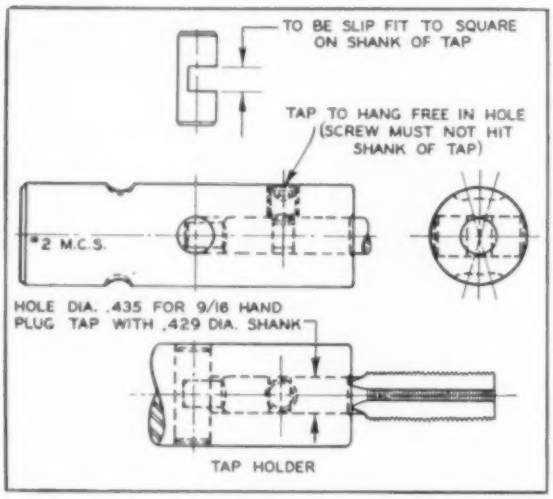
As shown in the sketch, the device is mounted on a hydraulic press. Dimension as shown in the detail of the shape of the centers varies between 1/16 and 3/16 in. for shafts of finished diameters of 1/8 to 2 in. Centerholes are produced by putting the work in the lower cup and lowering the plunger fast until the upper cup reaches the work. The plunger is then slowly lowered further. First the spring-loaded conical cups are pushed back, centering the work. When the pressure has reached a predetermined value, the downward travel of the plunger stops and is rapidly withdrawn.

This device saves about two minutes per shaft, eliminates center drill breakage, and assures concentricity of the center hole and the outside diameter of the shaft within 0.002 in. total indicator reading. The line between the two centerholes is also the center line of each of the two centerholes because the initial alignment of the device on the press was good.

F. C. Wevers
Hengelo (O), Holland

Tap Holder

This tap holder can be made quickly and inexpensively for use on drill presses, tapping machines and screw machines. It provides greater floating action than the usual tap holders which have a broached or filed square hole through the holder to act as a driver.

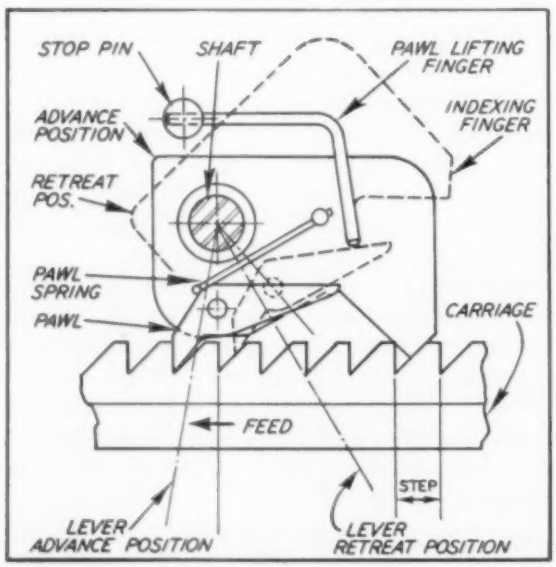

TO BE SLIP FIT TO SQUARE ON SHANK OF TAP
TAP TO HANG FREE IN HOLE (SCREW MUST NOT HIT SHANK OF TAP)
*2 M.C.S.
HOLE DIA. .435 FOR 9/16 HAND PLUG TAP WITH .429 DIA. SHANK
TAP HOLDER

As shown here, the round slotted driver pin is slip fit in the hole through the holder. This pin can be replaced at small cost in a very short time if broken. The set screw on the side allows the tap to hang freely in the hole, thus allowing greater floating action which will reduce the percentage of tap breakage.

Richard F. Johnson
Racine, Wisconsin

Pawl and Ratchet

In designing a spot welding fixture, in addition to clamping and locating, it is necessary to feed the work through the throat of the welding machine in steps so that the welds are made at definite intervals. The accompanying sketch shows such a mechanism for step feeding, positive indexing and pawl lifting after welding and the work is pulled out.

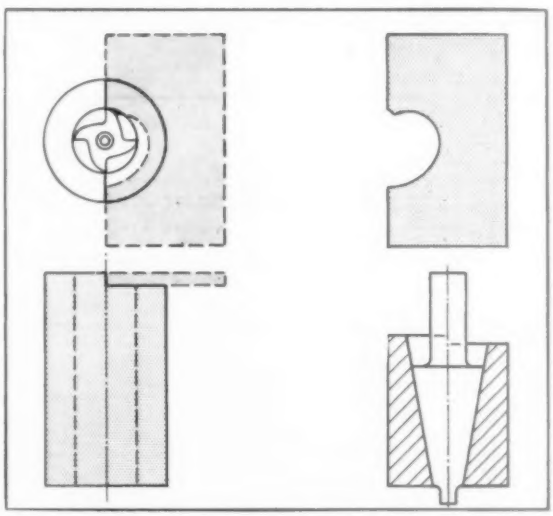


Each swing of the lever from the retreat position to the advance position moves the carriage forward one step and the indexing finger puts the carriage in position positively after it has been advanced. When the spot welding along the line is finished and the work is to be pulled out, the lever is pulled a little further to the right of the retreat position until stopped by the stop pin. In that position, the pawl lifting finger lifts the pawl tip above the tooth so that the carriage can be moved freely.

K. C. Hu
Philadelphia, Pa.

Regrinding End Mills

When regrinding end mills, it is important to be sure of having proper cutting clearance angles. When a special protractor is not available, the following method can be used for gaging the angle.



A hole is drilled and reamed in a short bar of steel to fit the shank of the end mill. A step about 1/16 in. deep is milled on one end up to the center of the hole. A templet of light gage steel has the correct angle filed with respect to the gaging edge. This angle would be best fitted to a new end mill. Clearance is cut out of the templet for the rest of the end mill. The secondary clearance angle can be filed at the other end of this cutout part if desired. Bushings may be used to reduce the hole size to suit smaller diameter end mills. For tapered shank end mills, the holder would be extended at the large end of the tapered hole until that end reaches the cutting teeth.

N. Schwartz
New York City

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Gunnison Homes:

New Thinking in an Old Industry

By Gilbert P. Muir

THE APPLICATION of aircraft design principles and metalworking manufacturing techniques to home construction has resulted in an operation at Gunnison Homes, Inc., which to the layman appears revolutionary.

Gunnison Homes, a U. S. Steel subsidiary at New Albany, Indiana, turns out ready-to-assemble prefabricated houses in a variety of designs at a capacity rate of 40 houses per day. Consisting basically of standard four-foot panels which utilize the aircraft industry's stressed-skin principle, the houses are produced on an assembly line which incorporates smooth flow and materials handling on a high level.

Gunnison was founded in 1936 by Foster Gunnison, and pioneered much of the early work in prefabricated housing. From the first Gunnison's designs incorporated the four foot modular principle, which permitted a wide variation in house designs with a minimum number of standardized interior and exterior panels. This, obviously, is one of the biggest contributions to low-cost manufacturing.

Earlier designs ranged to $40,000 homes; emphasis now is directed entirely to the lower- and middle-priced houses. Gunnison became a U. S. Steel subsidiary in 1944. In July, 1949, Brig. Gen. John J. O'Brien became its new president. In September of that year Gunnison hit a new stride with the introduction of the low-cost Champion Home, which sold nationally at an average price of $6300, including lot.

Gen. John J. O'Brien, Gunnison president, with a reproduction of a Gunnison development in the background.

The popular Champion Home is still a good seller. Subsequent popular models include the Coronado, introduced for 1951, and the 1952 model, the Catalina. The Catalina, Gunnison's higher-bracket home, is said to be the first L-shaped design in the moderate priced prefabricated market, and sells for between $8-13,000 including lot, and depending upon individual selections.

The Man

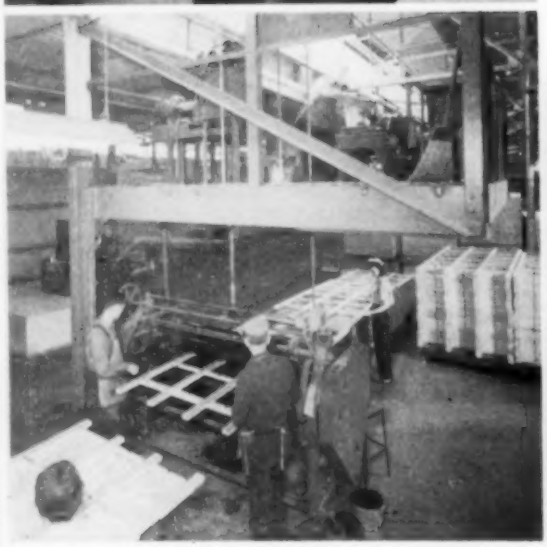
Gunnison's General O'Brien, now making and selling houses in quantity, was formerly the world's largest real estate operator. As the Army's Director of Real Property he controlled some 43,000,000 acres in various parts of the world, including Chicago's Conrad Hilton Hotel, which at one time during the war was an Army Air Corps training school.

O'Brien is a believer in quality. He believes in prefabrication in a positive sense—it is a superior competitor to lower-priced conventionally-built houses, and he proves that prefabrication can produce a better house at a lower price than can the conventional builder.

The twin keys to providing a well-built, low-cost house are, of course, design and efficient manufacturing. His encouragement—and insistence—on faster, smoother handling has helped to put Gunnison into the mass-production ranks.

The Product

The entire Gunnison home—interior and exterior walls, roof, doors



and windows—is assembled from prefabricated panels four feet wide and bolted together at the site. Each panel is a complete air- and water-tight unit. Each panel is a precision built unit, factory finished on all exposed surfaces, which can be fitted with other panels into a home, without cutting on the job. The panels are designed so that, when erected the joints are air and water tight.

Interior and exterior wall sections are basically the same, except that exterior sections are filled with mineral fibre insulation. Effectiveness of the insulation is indicated by the fact that a considerable number of standard houses have been erected in northern Alaska, and severe wind and weather conditions there have not made modifications necessary.

Mill Room to Assembly

We mentioned earlier that the Gunnison house is designed along aircraft stressed-skin principles. This similarity is carried on further in assembly operations.

As shown on the diagrammatic floor plan, panel assembly begins with a cross-flow of material to the actual assembly area. At one end of this T arrangement is the mill room, where framing members are cut to size for assembly.

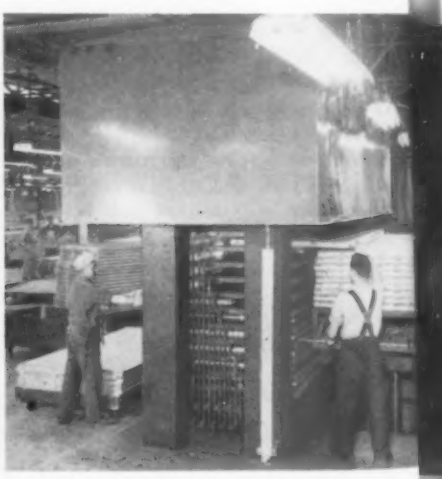
First framing operation is the molder, where 2x6's are sized for width and thickness in the same operation, ripped to form a number of members, and fluted down the length to provide ventilation and high glue bond strength.

The milled lengths fall to a conveyor and are moved to a combination unit which cuts members to length and bores necessary holes at each end of the sawed length. The machine is controlled from one position, and air-operated clamps are used to hold the stock during the operation.

Sawed material is segregated by length on a power conveyor, with some going on to an additional cut-off machine for sawing into shorter lengths for cross-members. Short lengths are notched to permit air circulation and insulation of wiring through the panel.

In addition to wall panel members, ceiling and roof components are run through other lines in the mill room, where they are cut to length, mitered, and holes bored for assembly.

The production sequence of a Gunnison home. (Top to bottom): Lumber in storage preparatory to cutting and finishing. Plywood sheets are shown below being sized for interior and exterior wall panels. Meanwhile, as shown at bottom, interior framework of the panel is assembled and run through glue rolls prior to assembly of the panel. (Below, left) Insulation is installed in the panels and top plywood sheet fastened to frame. At right is the ten-platen bonding press which seals panel into air- and weather-tight unit.



Plywood—Storage and Inspection

Gunnison's plywood handling, with the qualities involved, is one of the plant's major problems. Incoming plywood sheets from cars move along a belt conveyor, where receiving inspection is performed and minor flaws are sanded and repaired. Sheets with major defects are segregated for cutting into smaller pieces. Movement from conveyor to storage is by fork truck carrying palleted loads.

Gunnison's panels are designed to provide maximum usage of standard sizes of plywood, and this, coupled with a good quality performance, holds scrap losses to about one percent of the material accepted.

Plywood sheets from storage are cut to width on self-feed ripsaws and to length on double-end high-speed cutoff saws. Full plywood sheets then move to a double end tenoner for final accurate sizing.

High-speed routing of window areas in the solid plywood sheets is handled by a templet-guided router operating at 14,000 rpm.

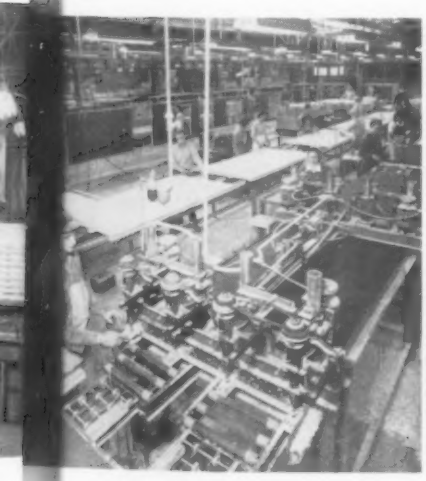
Stock doors are cut to size in this area—openings for lock sets and hinges are mortised, a water seal is cut in the bottom of the door, and all edges treated with a preservative. Other miscellaneous operations include cutting of shelves for various parts of the house. Shelves are cut and the edges are eased ready for assembly.

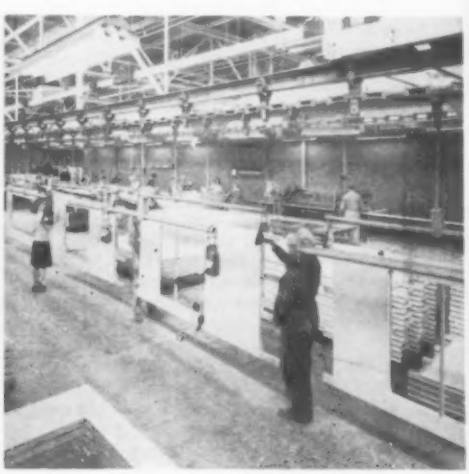
Wall Panel Assembly

The beginning of the wall assembly line—largest in Gunnison's plant—is the merger of the two supply lines from the mill room at one end of the T, and the plywood storage and cutting area at the other end.

Framing members from the mill room move into assembly in trucks, and the interior frame of the panel is assembled from this stock on jig assembly tables. Air-operated clamps hold members in position after components are fitted against guides on the table, and air-powered stapling guns are used to tack members together.

Eight jig tables are used for assembly of frames for the various wall panels going into a complete house, including two for the assorted exterior panels, two for solid ex-





(In counter-clockwise order, left to right and bottom to top) Press curing is followed by automatic milling, and in this operation all required bolt holes are drilled and counterbored. Next panel shows conveyor inspection prior to finishing, and then to the spray booths and drying oven. Interior door panels awaiting finishing are stacked in foreground. Trim is shown being installed in photo above—all weatherstripping and hardware are included before shipment. At top are window panels having trim finished before shipment.

terior panels, one for standard exterior window panels, one for exterior door panels and picture window panels, one for interior wall panels and one for closet front frames, and two for various types of wall panels.

Frames are stacked by type on separate trucks, then transported to the feeding table serving the glue spreader. In one pass both sides of the wall panel frame are coated with a liquid thermosetting resorcinol-type glue. This glue, after the hot press bonding operation described later, forms a bond stronger than wood, and is resistant to water, fungi and insects.

A plywood sheet is positioned on a jig table at the discharge end of the glue spreader, and the glue coated panel frame passes by conveyor to the table, and is positioned on the plywood sheet with the aid of squaring devices at both ends and air clamps. Brads are used to fasten the sheet temporarily to the frame, and the unit passes to the next table where insulation is placed between cross-members, and a second plywood sheet is fastened to the other side of the frame.

Assembled frames are moved by dolly—ten frames to the load—to the hot plate platen press for curing. This press is capable of simultaneously pressing ten 4 by 8 foot panels. A hydraulic lifting device at the side of the press raises the dolly so that the top panel is level with the top platen of the press, and the ten platens are loaded downward in this manner. The steam-heated press bonds the plywood and glue in a 6 - 7 minute cycle, using 250 psi pressure at 290 deg. F.

Panels removed from the press are held for a minimum of two hours to permit cooling and stabilization.

Four popular Gunnison models are shown in the panel at left. At top is the lower-priced Champion with picture-window design. Below is the Coronado with window bay—a larger design. Next is the Coronado in another variation which includes window wall and porch. At bottom is the Catalina, Gunnison's l a r g e s t, which features an Ell-shaped design and window wall.

Final machining on the panel is even more mechanized than earlier operations. The dried panel is removed from the holding trucks, placed on a roller conveyor, and fed into a tenoner where a spline groove is milled in the side edge of the panel. A power roller conveyor takes the panel to an eight-spindle gang drilling setup where all holes perpendicular to the panel face are drilled and counterbored. Air-operated interlocks position the panel throughout the operation.

The panel continues on the conveyor to receive a primer coating on the side edges, then on to the end where it is turned over and placed on a second conveyor running in a return direction. Caulking compound is mechanically applied and a spline is nailed in the spline groove of each panel, then, as the panel moves along, the top face is prepared for finishing. Power-driven, brush-type dusters with a vacuum pick-up are located at the end of the conveyor to remove dust from both sides of the panel. Finally, panels are hung on the moving overhead conveyor for transporting to and through the finishing booths.

Panel Finishing

Panels are painted (on exterior side) in reverse-type water-washed spray booths staggered on both sides of an imaginary line, so that different finishes can be applied to each side of a panel as it passes through the booths. After each sequence panels are routed through a hot-air drying oven which has a progressive temperature beginning at 80 deg F at the entrance and rising to 135 deg F at the far end. Two sets of reverse spray booths and the conveyorized loop-type oven are provided for production work on wall panels, with a fifth booth for miscellaneous and rework. Trim sections follow a smaller conveyor through an automatically-operated six-gun spray booth, then through an oven for drying. The trim spray line is operated from one point of control—at the beginning of the conveyor—with an automatic bell alarm system on the line as an additional safeguard.

Ceilings and Roofs

Both ceiling and roof assemblies are manufactured to the same four-foot wide modular design as the wall sections just described. Assembly techniques also are similar, with ceiling (or roof) joists trucked from the mill room to air-operated jig tables for assembly. Supporting members are nailed into position, and the unit transported to a conveyor, where the ceiling (or roof) plywood is installed with glue and fastened with divergent-type staples. The ceiling assembly is prepared for finishing and moved to a spray booth for a texture-type coating.

Gables for various Gunnison models are similarly assembled on jig tables and moved through the spray booth on individual trucks.

Materials Handling

In general, materials handling techniques have been covered in the description of the associated operation. Throughout the Gunnison plant, roller and overhead conveyors are used extensively, and fork trucks are employed where conveyors are not available. The plant uses about 25 gas fork trucks and seven electric transporters.

Inspection

Gunnison uses progressive process inspection throughout the manufacturing cycle. Beginning with receiving inspection, all material is inspected at least once after each fabricating operation, with close process inspection during assembly. Final inspection is made after finishing for acceptance for shipment.

A testing laboratory is maintained at the plant, in addition to extensive facilities at another location, for testing plywood strength, glue properties, fasteners, etc., as well as tests on new materials being considered for possible future use. Accelerated testing of materials and assemblies is farmed out to commercial laboratories, while exposure tests to determine effects of elements on materials or components are carried on at the plant.

Warehousing and Storage

On Gunnison's normal shipping schedule, completed housing units are held in storage for less than a day before removal by truck or rail. The factory balance at the end of the line is equivalent to about 10 houses.

The straight-flow production line is carried through to shipping. Truck loading platforms are at the end of the line, and four rail spurs enter the plant at the rear, permitting loading from the production floor on one side and from the warehouse on the other. Average loading is one complete house per truck trailer, and two smaller houses per boxcar.

Warehousing facilities are maintained primarily for vendors' items which are received ready for shipment with the house. These include sinks, cabinets, lighting and heating fixtures, furnaces and water heaters, and are included with the house package along with an assembly box which contains all the nuts, bolts, fittings, etc., required to assemble the house. Plumbing and bathroom fixtures and electrical wiring are purchased and installed by the dealer on the site.

Production Planning

To a certain extent sales, and therefore production in the prefabricated house industry, follow the seasonal curve of conventional building. (This is alleviated to some degree by the fact that a national organization can ship and erect in the south during northern winters.) Therefore a flexible system of production and planning controls is desirable, and Gunnison has achieved this to an efficient degree.

All materials and production planning has as its basis the company's budgeted sales forecast over a several months' period. Precise historical data provide an accurate rundown of required material per house produced, and this average figure is used as the basis for orders for future delivery of materials. The figure actually represents material required per standard housing unit, and on any sales forecast, therefore, the models budgeted are considered in terms of size relative to the standard unit.

The simplicity of the system is seen in the fact that control over an inventory averaging $2,500,000 is maintained by three raw materials control specialists and two clerk-typists. A constant comparison between actual usage of materials and estimated usage confirms the accuracy of estimates and serves as a check on allowances.

Production scheduling is on a weekly basis over a four-week forecast. As in most assembly operations the total number of complete units is translated into required components to assemble these units, and production scheduling is on the basis of the needed components.

Individual schedules are issued to various control points such as the panel-bonding press, which governs production ahead of that operation. Component scheduling amounts to maintaining an arbitrary floating inventory at each station on the assembly line, with visual control rather than specific schedules.

The Future

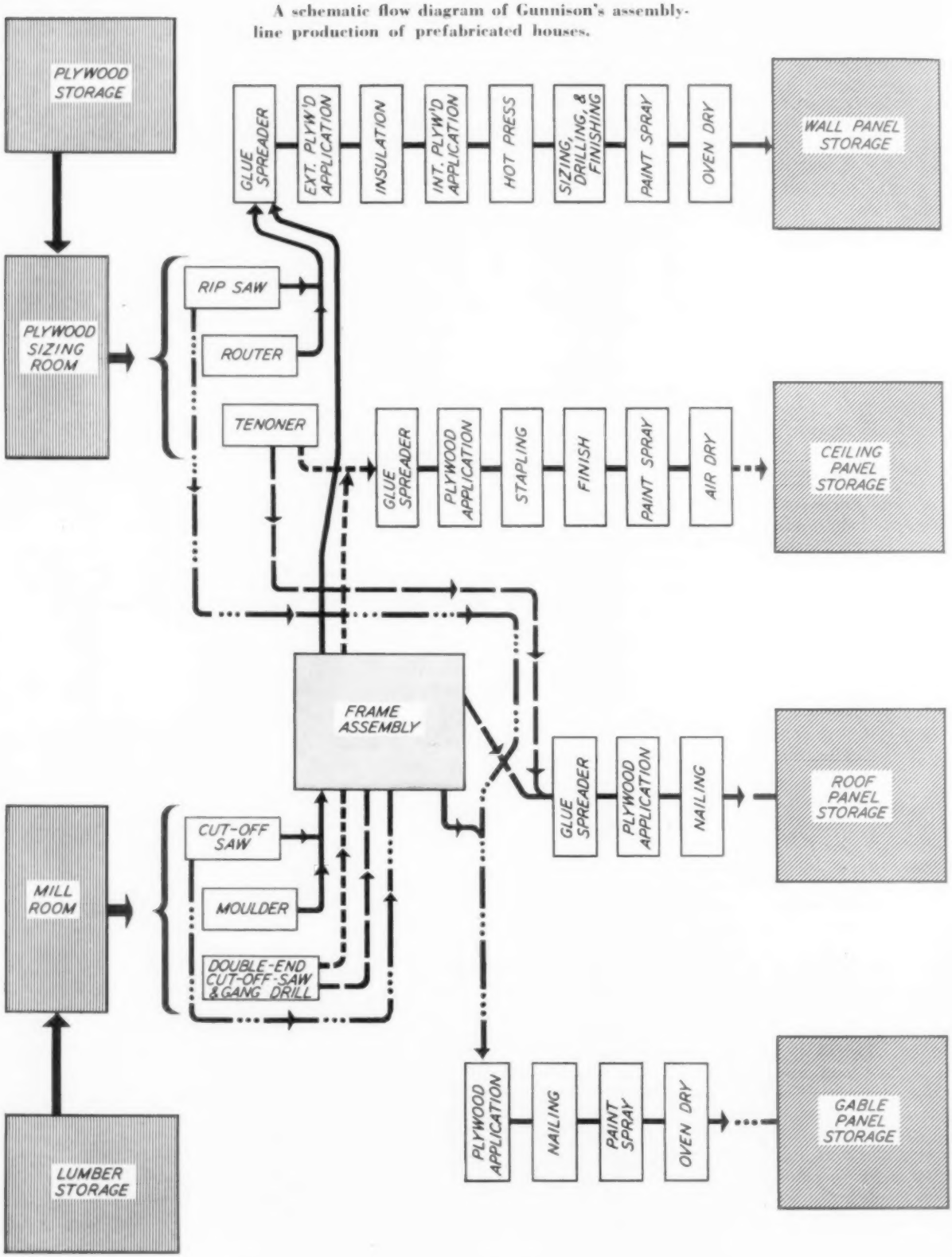
What is the future for prefabricated houses? O'Brien states flatly that no conventionally-built house in his bracket can compete with his prefab on the basis of price or quality. He further points to the Gunnison houses erected more than sixteen years ago and, with reasonable care, as good as the day they were erected. Laboratory tests indicate the wooden model will withstand 22 times the maximum wind, snow and dead load combined anywhere in the United States.

Appearance is better than average, as can be seen from the cuts of a few Gunnison models. Considerably more space is provided than in a comparable conventionally-built house.

Finally, U. S. Steel will move into a new field in prefabrication next year when a new Gunnison plant opens outside Harrisburg, Pa., to turn out steel military shelters and hospitals for the services.

TOOL ENGINEERING IN *Action*

A schematic flow diagram of Gunnison's assembly-line production of prefabricated houses.



ASTE's Andy Rylander, second from right, presented the chairman's pin to Vincent E. Diehl, far left. Seated at the speakers' table are Ben J. Hazewinkel, second from left, and L. F. Hawes. In the photograph below is shown part of the crowd of 180 persons who witnessed the chartering ceremonies June 17 at Palo Alto.

Santa Clara Valley Chapter Chartered

By Nancy L. Morgan

Chartering ceremonies for the Society's 98th chapter, Santa Clara Valley, were held June 17 at a dinner meeting held at Dinah's Shack, Palo Alto, Calif.

Ben J. Hazewinkel, a national director of ASTE, officiated at the presentation of the charter to Vincent E. Diehl, chairman of the new chapter. Mr. Diehl received the gavel, a gift from Los Angeles members, from their chairman, Ralph Crissie. Andy Rylander, west coast representative of ASTE, presented the chairman's pin.

Other elected officers of the Santa Clara Valley chapter are: W. C. Lanyon, first vice chairman; E. F. Roskowski, second vice chairman; G. B. Randolph, secretary and R. D. Harper, treasurer.

L. F. Hawes, chairman of the national public relations committee, introduced Wayne Ewing, national membership committee area captain, who presented the membership kit to Don Lock. Other committee chairmen of the chapter are: G. W. Hilton, program; E. W. Reed, editorial; Prof. Carl Kaiser, education and Frank Menard, constitution and by-laws.

A congratulatory telegram to the new chapter from A. B. Clark, chairman of the national membership committee, was read to the 180 members and guests present for the ceremonies.

Bill Ware, one of the principal organizers of the Santa Clara Valley chapter, is leaving the area and was presented a *Tool Engineers Handbook* and a membership pin by Mr. Diehl.

Guests at the meeting included members of the Golden Gate and Los Angeles chapters and Commander D. J. Gray, J. J. McAuliffe, R. N. Parkin, E. J. Graham, Cam Jones, Vic Aleshin, C. J. Lindroth, J. P. Hahir, and A. Gabey.

Technical speaker, J. J. McGrann of the Steel & Tube Div., Timken Roller Bearing Co., discussed the history and application of Graphitic Tool Steels.

The members of the Santa Clara Valley chapter are: Hugh T. Adams, Richard A. Allen, Angelo E. Arata, Gilbert R. Barr, Clarence W. Beden, Norman A. Benson, Lisle O. Brown, Alfred K. Burriss, Jr., Vilas E. Childers, Ellwood J. Collins, Albert M. Compasso, John J. De Mello, Edward O.

(Continued on page 81)

When the national program and education committees of the Society met July 26, 27 and 28 in Detroit, one of the major events on the crowded work schedule for both groups was a joint dinner meeting held at the Statler Hotel with some of the national officers. Shown here are President L. B. Bellamy, left; R. F. Waindle, first vice president; and A. R. Diamond, chairman of the education committee.

James O. Horne, head of the national program committee, discusses the Society's Leadership Conference scheduled to be held next March in Detroit, with Harry E. Conrad, executive secretary of ASTE.

Col. Warner Discusses Army Ordnance Problems

Cedar Rapids—Coffee speaker at the May meeting of the Cedar Rapids ASTE chapter was the head football coach at Coe College, Dick Clausen, who gave an amusing and informative talk on subsidization of college athletes.

The technical program was provided by Col. W. W. Warner, commanding officer of the Rock Island Arsenal. He was introduced by Chapter Chairman Edwin Klouda.

Col. Warner first explained that much of what is publicized as waste in defense procurement is not actually waste, but made up of those items of expense familiar to any firm which is preparing to produce an entirely new product. This expense is somewhat exaggerated due to the rush with which armaments are ordered and the changes found necessary in designs and materials as first models are produced.

Heap Accepts Post With Madison Products

Frank Heap, treasurer of the Cincinnati chapter and who has been Cincinnati district manager for the Monarch Machine Tool Co. for the last nine years, has accepted a new position as district manager for a new water-soluble machining and grinding fluid being introduced by Madison Products Co., Toledo. The new fluid concentrate is a product of Master Chemical Corp.

Clark Elected to Vascoloy Presidency

Herbert B. Clark has been elected president of the Vascoloy-Ramet Corp., a subsidiary of the Fansteel Corp. A member of the St. Louis ASTE chapter, he began in 1939 as sales manager of the firm, later becoming vice president in charge of sales for both Vascoloy-Ramet and Fansteel. He was elected to the Fansteel board of directors in 1952.

Buffalo Chosen for Semi-Annual Meeting

ASTE's Semi-Annual Membership meeting will be held in Buffalo, N.Y. this year on October 10 and 11. Headquarters for the two-day event will be located at the Statler Hotel.

The program will include at least three technical papers, two plant tours, membership meeting, a banquet, a meeting of the Society's board of directors and a well-detailed list of ladies' activities.

Participating chapters are Buffalo-Niagara Frontier, Rochester, Syracuse, Mohawk Valley, Elmira, Erie, Toronto, Hamilton District, Niagara District, Peterboro, London-St. Thomas and Grand River Valley.

Standards Committee Approves Revised Scope

The Sectional Committee B52, for classification of materials for tools, dies, fixtures and gages, sponsored by ASTE, met May 15 at the Rackham Memorial Building in Detroit. It was attended by 16 members.

The revised scope for the establishment of a standard classification and the evaluation of materials for use in tools, dies, fixtures and gages was reported as adopted by letter ballot. The committee secretary was authorized to present the new scope to the American Standards Association for approval.

The committee also approved the new organizational chart presented at the meeting.

More than 300 members of ASTE checked in at the Society exhibit at the Canadian International Trade Fair held June 2-13 in Toronto. Pictured here are Cal Burke (far left), ASTE national headquarters staff; John Lengbridge (second from left) and Harry Whitehall (far right) area membership captain.

Atlanta Membership Campaign in Full Swing

Atlanta—In just 60 days, the current membership campaign netted 16 new members for the ASTE chapter of Atlanta, it was announced at the organization's April 21 meeting. Similar progress through the finish of the drive is expected by the membership committee which is in charge of the promotion.

Speaker at the meeting, held at the Elks Temple, was Parke Kinietz, coolant engineer, Frostrode Div., Viking Products, Vicksburg, Mich., who gave a brief historical resume of the inception and development of coolant cooling applications.

He discussed the difficulties encountered by manufacturers in meeting close tolerance specifications during World War II and stressed the point that mid-day maximums in coolant temperatures led to wide differences in workpiece and gage temperatures, a matter that resulted in a tremendous number of reject production pieces.

New Haven Picnic Closes 1951-52 Year

New Haven—A picnic at the summer home of F. W. Gilbert on River Road in Mt. Carmel, Hamden, Conn., on June 7 ended organized ASTE activities for the New Haven chapter until September.

A hike to the old Colonial Copper Mine, conducted by the host, highlighted a varied program which included baseball, golf, sack races and other contests.

Picnic tables and charcoal grills were set up for the occasion and the day's menu of hamburgers and hot dogs was enthusiastically received by the 60 members and guests present for the annual event.

Toledo Chapter Aids in Preparing Curriculum

The University of Toledo, in cooperation with the educational committee of the Toledo chapter has prepared a course in tool engineering which will be included in the Toledo, Ohio institution's curriculum starting this fall.

Raymond Peterson, Philip Lindhuber, Lorence Rennell, Lawrence Rothert, James Clark, Harry Nordgren, and Harvey Langenderfer of the Toledo chapter served on the educational committee to give assistance to the staff members of the university in the preparation of the curriculum.

The entire program can be completed in four years of evening study, and upon satisfactory completion a certificate of Associate in Industrial Science will be awarded the student.

More than 130 persons turned out for the May meeting of the New Orleans chapter held at Tulane University. Area Membership Captain Robert W. Miller, standing, far right, spoke to the group on the current membership campaign. Technical speaker was J. B. Wilkie, standing, center, who presented a program on modern gaging practice. He is a sales engineering executive with Pratt & Whitney, West Hartford, Conn. Others pictured are: (seated) A. R. Ryan, treasurer; L. C. McKinley, first vice chairman; M. P. Chatry, second vice chairman. Standing: Ed Graf, secretary; Doug White, Houston chapter; Mr. Wilkie; J. R. Cypher, New Orleans chapter chairman, and Mr. Miller.

POSITIONS AVAILABLE

PRODUCTION ENGINEER—An important aircraft engine accessory manufacturing company in Central Connecticut area requires a first-class man to help organize and control its production engineering department. The successful applicant must have a proven record of accomplishment, and have experience in the manufacture of small precision engineering products such as aircraft engine accessories. He must have an outstanding knowledge and experience in machine shop methods, and be thoroughly acquainted with tool design and tool manufacture. He must also have a wide experience in operation layouts, time study, estimating plant layout and be able to coordinate processing and tool design and supervise these activities. A sound knowledge of assembly methods is also an advantage. This man must be a self-starter and fully competent in this field. Good prospects and salary for the right man. Reply, giving resume of education, experience and salary requirements, etc. to Box 44, THE TOOL ENGINEER, 10700 Puritan Ave., Detroit 21, Mich.

TOOL AND MACHINE DESIGNERS—One of Cincinnati's largest permanent design firms has openings in their own office for experienced machine, product and tool designers, and detailers.

Recent engineering graduates or students will also be given consideration. These are permanent positions with a substantial, stable leader in the field. We can offer top starting wages, modern working conditions, paid holidays, vacations, and other benefits. Our policies assure varied experience and unusual opportunities with a future.

New employees would be expected to settle on a permanent basis in Cincinnati. Please send resume to Cincinnati Designing, Inc., 37 W. Seventh St., Cincinnati 2, Ohio.

DEVELOPMENT AND TOOL ENGINEERS—Positions with well-established firm, rated AA-A1, doing both consumer goods (metal housewares) and defense work. An excellent opportunity in an expanding organization. Only 30 miles north of Milwaukee.

Applicants for each position should write fully about education, experience, present work, personal data—including age, marital status and present earnings. A personal interview will be arranged later. Inquiries will be strictly confidential. Address correspondence to Personnel Dept., West Bend Aluminum Co., West Bend, Wis.

TOOL ENGINEER—First-class tool engineer required in aircraft accessory division of a large manufacturing company located in Central Connecticut. Suitable applicants must have a wide experience in the design, development and manufacture of complicated jigs, fixtures and tools for production of precision parts. The person must have a thorough practical training and sound technical qualifications. Formal education secondary to real experience and ability in this field. This position calls for a really first-class man and only such men should apply. Excellent salary and future prospects under good working conditions. Send resume of education, experience and salary required. All replies will be promptly considered and kept strictly confidential. Address replies to Box 30, THE TOOL ENGINEER, 10700 Puritan Ave., Detroit 21, Mich.

TOOL ENGINEERS — Cooling tower manufacturer has permanent positions for tool and machine design engineers. Several years experience and mechanical degree desirable. Positions located in home office. Excellent opportunity, full employee benefits and attractive salary. Call, wire, write or apply in person. Personnel Dept., The Marley Co., Inc., 222 W. Gregory Blvd., Kansis City, Mo.

A. A. Merry Addresses Hartford Night Audience

Hartford—June 9 was the date of the 1952 Hartford Night, the sixteenth staged by ASTE members of the Hartford chapter. More than 325 persons attended the banquet meeting held in the ballroom of the Hotel Bond.

Keynote speaker was Arthur A. Merry, chief advanced tool engineer with Pratt & Whitney Aircraft Div., United Aircraft Corp. His subject was "The Tool Engineer's Influence on Producibility."

L. B. Bellamy, national president of ASTE, presented his greetings in an after-dinner talk.

Other national officers attending Hartford Night were: Roger F. Waindle, first vice president; J. P. Crosby, second vice president; William F. Jarvis, chairman of the national finance committee; and Harry E. Conrad, executive secretary.

Presiding at the meeting was Henry E. Kuryla, chairman of the Hartford chapter. Toastmaster for the evening was Ray H. Morris, past national president of the Society.

Among the special guests were W. Arthur Countryman, Jr., acting mayor of the city of Hartford; L. M. Bingham, secretary, Mfrs. Assoc. of Conn., Inc.; A. H. D'Arcambal, past national ASTE president and vice president of Pratt & Whitney; Irwin F. Holland, past national ASTE president and general superintendent, Pratt & Whitney; Frederick U. Conard, president, Pratt & Whitney; Henry Sharpe, president, Brown & Sharpe Mfg. Co.; A. A. Jones, chief engineer, Norden Instruments, Inc.; Richard Howes, Connecticut Dept. of Education; Thomas Hollis, Jr., vice president and general manager, Nelco Tool Co., Inc.

Still others were: Edmond Morancy, sales manager, United Tool and Die Co.; Jeremiah J. Fazioli, chief tool engineer, Bush Mfg. Co.; James Skinner, vice president, Skinner Chuck Co.; P. H. Hatch, vice president, Brown & Sharpe Mfg. Co.; B. F. Conner, president, Colts Patent Fire Arms Mfg. Co.; W. C. Stauble, executive vice president, The Holo-Krome Screw Corp.; L. O. Favreau, supervisor of manufacturing engineering, Kaman Aircraft Corp.; Elmer E. Legge, general manager, Henry & Wright Mfg. Co.; Ed Bullard, chief of production engineering, Pratt & Whitney; Henry J. Anthony, chief tool and equipment engineer, Whitney Chain Mfg.; E. S. Grant, vice president, Allen Mfg. Co.; Albert E. Englund, vice president in charge of production, Jacobs Mfg. Co.; and D. J. Crombie, assistant works manager, Underwood Corp.

"Strictly social" sums up the May meeting held by members of the Los Angeles chapter held at the Old Dixie Restaurant. About 520 persons were on hand for the dinner and entertainment which included a variety show. Among those present were, from left: M. De Paola, Carl Price, L. W. Goodwin, Tom Sloane and William Garnett.

Banner Presented to New Orleans Chapter

New Orleans—Presentation of an ASTE banner to New Orleans members from the Houston chapter was a program highlight at the May 13 meeting held at Tulane University. The national membership committee was represented by Robert W. Miller, area captain, who spoke to the 130 persons present on the chapter's membership campaign.

The technical session following dinner was titled "Modern Gaging Practice" and presented by J. B. Wilkie, sales engineering executive, Pratt & Whitney, West Hartford, Conn.

Visitors from the Houston chapter were introduced by Second Vice Chairman Milton Chatry, who conducted the meeting.

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New Jersey Picnic Attended by 500 Members

Livingston, N.J.—Doerrs Grove furnished the setting for the spring picnic sponsored June 7 by the Northern New Jersey ASTE chapter. The annual affair was attended by nearly 500 tool engineers and guests.

Clear skies and a warm Saturday afternoon were instrumental in making the outing one of the most successful in chapter history. Baseball, a horseshoe pitching contest, nail driving, three-legged races and a tug-of-war punctuated the recreation program.

Chairman of the event was Carl L. Slonkosky, entertainment chairman. He was assisted by Chairman Clyde Shannon, First Vice Chairman W. E. Wheaton, Second Vice Chairman J. W. Wanelik, Secretary H. W. Ryno, Treasurer A. J. Wotowicz, Plant Coordinator N. James Bosted and Past Chairman James Allen.

Others who contributed to the picnic were: Alexander Hylicke, Albert Schmidt, Loren F. Gay, Jack Robinson, Anthony F. Cuoco, Vincent Agurti, Charles Bazaa, J. Friegel, B. Lamb and G. H. Grossnickle.

Movies Shown on Outboard Motors

Kansas City, Mo.—Albert Stahl, a representative of Johnson Motors, addressed the June meeting of the Kansas City ASTE chapter. The technical session and dinner were held at Roselli's Restaurant.

Mr. Stahl showed two films on the applications of Johnson outboard motors and answered questions from the floor in a discussion period.

Atwood Retires

Carl W. Atwood, district manager of the Hartford, Conn. territory for the Norton Co., retired July 1 after 32 years with the firm. He is a member of the Hartford ASTE chapter.

Fond du Lac Sponsors Student Guidance Program

Fond du Lac—About 75 graduating high school seniors and vocational school students and their instructors were entertained at a special student guidance program staged May 14 by the Fond du Lac ASTE chapter.

A tour through the Wisconsin Axle Div., Timken-Detroit Axle Co. opened the day's activities at 3 p.m. Following the plant tour, a banquet was held in the dining room of the Athearn Hotel where B. W. Keese, chief engineer with the firm, acted as toastmaster.

Featured speaker was E. A. Reed, assistant chairman of the Industrial Engineering Dept., General Motors Institute. His subject was "Possibilities and Opportunities of Tool Engineering."

He outlined the place of the tool engineer in industry and informed the student guests of the training necessary to develop a tool engineer.

One of the highlights of the address was the illustration of a machine part, the fan pulley for an automobile, and a description of the processes involved in making it. Enlarged drawings and a ten-minute motion picture showed the progression of the part through the various processes to completion.

The purpose of the meeting was stimulating interest in the tool engineering profession. The Fox River Valley in Wisconsin and the surrounding industrial district presents many opportunities in the tool engineering field which are not generally realized by the students at the high school level.

In years past, many students from the area have moved to the eastern industrial districts looking for opportunities which existed in their own home locality.

At present, the supply of trained engineers is extremely critical and relief from the shortage will depend upon the interest of the present graduating high school students.

W. A. Papworth

The Fond du Lac chapter was assisted in its student guidance program at Oshkosh by the following companies: Giddings & Lewis Machine Tool Co., Tobin Tool and Die Co., Kaukauna Machine Corp., Valley Iron Works, Appleton Machine Co., H. G. Weber Co., Eclipse Mfg. Co., The Vollrath Co., Polar Ware Co., J. Deere-Van Brunt Co., Brillion Iron Works, Hamilton Mfg. Co., Paragon Electric Co., Metal Ware Corp., Kohler Co., Hudson-Sharp Machine Co., Cleereman Machine Co., Packer Mfg. Co., Manitowoc Shipbuilding Co., Wisconsin Axle Division, and Kaufman Mfg. Co.

Gamewell Names Joyce

Frank B. Joyce, Hartford member, has been named works manager of the Gamewell Co., Newton Upper Falls, Mass. Since 1944 Mr. Joyce has served as factory manager of the Henry S. Wright Div., Emhart Mfg. Co., Hartford, Conn.

Philadelphia Holds Final Technical Session

Philadelphia—The Philadelphia chapter completed its technical sessions for the season on May 15 at the Engineers Club when ASTE members heard W. A. Papworth, staff engineer, Porter Cable Machine Co., Syracuse, N.Y. The subject of his talk was "Abrasive Belts to Speed Production."

Mr. Papworth spoke of the advantages of the abrasive belt processes over set-up grinding wheels and milling, where accuracy requirements and work shape permits. He also discussed product redesign for the effective use of belts. Slides of machines and applications to work of various materials supplemented his talk.

A colored sound film on finishing jet-engine turbine and compressor blades by the use of abrasive belts, both manual and by machine, was shown under the sponsorship of Carborundum Co.

About 70 members and guests attended dinner and 125 were present for the meeting.

Elected Vice President

Harry W. Highriter, Chicago member, has been elected vice president of Vascoloy-Ramet Corp. Mr. Highriter joined the technical staff in 1940 and became technical director in 1946.

South Bend Members Hold Annual Outing

South Bend—ASTE members and their guests, more than 300 persons, traveled to Dowagiac, Michigan, June 21 for the annual picnic and golf outing held at Indian Lake Golf Club.

Golfing attracted half the crowd, the largest ever to attend such an affair, and horseshoe pitching, dart games, and other outdoor activities kept the remainder of picnic participants busy.

Committee members who helped plan the South Bend annual outing, front row from left, were: Jim Kemp, food; Walter Prolaska, refreshments; Harold Housewerth, games. Standing: Larry Haverstock, general chairman; Paul Beeler, reservations; Jim Nelson, golf and Roscoe Beebe, entertainment.

The Chicago ASTE chapter held its annual golf meet at Silver Lake on June 7. About 150 members and guests attended. Dinner was served in the evening and a variety show provided entertainment. Golfers pictured here are: Frank Mertz, Peter Cox, Ben Fleury (membership chairman) and Al Grove.

Evansville Holds Executives Night

Evansville—Top management representatives from all local industry and leaders in various civic organizations joined forces May 12 with Evansville ASTE members for the first annual Executives Night meeting of the chapter.

National Treasurer Howard McMillen, past president of the Evansville chapter, spoke on the contributions made to industry by the Society.

Technical speaker was George Alexander Bowie of the Firestone Tire & Rubber Co., who discussed personal development in his talk on "How Do I Look?"

Entertainment for the evening was furnished by one of the nation's youngest barbershop quartets, "The Four Chips," whose ages range from 8 to 14 years.

Attendance at the meeting, one of the most successful ever staged by the chapter, totaled nearly 130 members and guests.

Several attendance records were broken May 12 by the Evansville chapter when 130 members and guests attended the first annual Executives Night. Speakers were George A. Bowie, second from left, of the Firestone Tire & Rubber Co. and Howard McMillen, second from right, national treasurer of ASTE. With them are Harry Newcomb, left, and H. J. Pernicka.

K. W. Riddle Named Dean at Drexel Institute

Kenneth W. Riddle, member of the Philadelphia chapter and of the Society's national program committee, has been given the title of dean of the Evening College of Drexel Institute of Technology. He has directed the college since 1948 and has served on Drexel's faculty since 1929.

Baltimore Chapter Hears Dr. Tarasov

Baltimore—The Engineers Club was the setting for the May 7 dinner meeting of the Baltimore chapter. Coffee speaker was Leslie MacGregor who spoke on "Some Aspects of Industrial Leadership." Jack Forsythe of Short Bros. and Harland, Belfast, Ireland, who is visiting the United States as guest of the Glenn L. Martin Co. to analyze American methods in building aircraft, gave a short talk on his experiences.

The technical program on metallurgical aids to better grinding was presented by Dr. Leo P. Tarasov, head metallurgist, Research and Development Dept., Norton Co. He discussed the quality of ground surfaces and the metallurgical and physical aspects of grinding. Simple trouble-shooting methods, based on metallurgical principles, to determine the most economical ways of solving a variety of grinding difficulties were covered by Dr. Tarasov.

AiResearch Tour Draws 240 Los Angeles Members

Los Angeles—AiResearch Mfg. Co. was host to 240 members and guests of the Los Angeles ASTE chapter for a plant tour on June 12. They toured the entire manufacturing facilities, as well as 12 different research divisions in the laboratory area.

In viewing the machine shop, the group observed tooling and production machine operations, gear and thread grinding, impact extrusion and other special work, much of it at tolerances of one ten-thousandth of an inch.

Visiting the aluminum welding and brazing facilities, the ASTE members saw the unique three-dimension duplicators manufacturing high-speed turbine wheels. In process were the oil cooler and heat exchanger fabrication, electric motor winding, electric and electronic assembly, air value manufacture, aluminum tube extrusion, extremely close sheet metal work and air turbine and gas turbine engine assembly.

The tour was also conducted through a battery of air turbine test cells where equipment was operating at speeds of 1,000,000 rpm, through complete electrical and electronic research departments where products go through 17 environmental tests, and chemical and metallurgical divisions.

One of the outstanding parts of the tour was the view of the unique strato chambers where altitudes of 100,000 ft and temperatures of minus 85 deg F can be simulated. The laboratory area also boasts one of the most unusual precision casting departments on the west coast.

Los Angeles tool engineers participating in the AiResearch Mfg. Co. tour on June 12 were divided into groups of 20-25 men each for more individual attention. More than 240 members visited the firm.

Osborn Elected State Exchange Club President

Dr. Harry B. Osborn, Jr., third vice president of the Society and a national director, was elected state president of the 62 Exchange Clubs of Ohio at the organization's annual convention held in June. He had previously served as a member of the board of control and as vice president. He is technical director of the Tocco Division of the Ohio Crankshaft Co.

Donovan Conducts Special Ladies' Quiz

Wood carvings made by hand were awarded as quiz prizes by National Director T. J. Donovan, Jr., at the Ladies' Night program of the Potomac chapter. The special quiz show, designated erroneously in the June issue of THE TOOL ENGINEER as a silver dollar quiz, was conducted by Mr. Donovan for the participation of the ladies present for the meeting.

Outstanding Student Honored by Akron

Akron—Emanuel T. Fundoukos, student at Akron University, was awarded *Tool Engineers Handbook* for his outstanding work as a mechanical engineering major. The presentation was made June 3 by A. O. Hunt, chapter chairman; Frank Flannery, education chairman and Prof. Petry, head of the mechanical engineering department.

Tapping Problems Covered by Carruthers

Toledo—Dinner served at the Maumee River Yacht Club preceded the May 14th technical session of the Toledo chapter. Speaker at the meeting was Allan J. Carruthers, research engineer, Greenfield Tap and Die Co.

Mr. Carruthers spoke on "Measuring and Interpreting the Factors in Tapping Torques." Using slides and charts for illustration, he explained performance characteristics of various types of taps in various materials. A lively question period indicated to many that tapping is somewhat of a problem to most manufacturers.

New Chapter Chartered

(Continued from page 75)

Doepke, John A. Durst, Jr., Ralph G. Fitzgerald, William H. Forbes, John L. Fournier, George D. Geddes, Richard F. Gibbons, Russell P. Givenco, Cary B. Griffith, John Groves, Clement R. Guzzetti, Chester C. Hanson, Robert D. Harper, Wallace H. Harrison, Glenn O. Herreman, Theodore D. Hill, Gilbert W. Hilton, Virgil T. Horn, James M. Johnson, James M. Jones.

Carl F. Kaiser, Gordon Keith, Donald R. King, Floyd L. King, Robert B. Kolbo, Rudolph Komuchar, Kenneth Krohncke, William C. Lanyon, Donald D. Locke, Robert W. Marshman, Dennis E. McCarty, Hugh H. McGee, Dominic C. Mercurio, Bernice W. Newberry, Clifford F. Oliver, Garland C. Oliver, Ralph E. Olsen, Alex D. Peresich, Jack H. Petersen, Hugh L. Phillips, James A. Porter, Edward W. Reed, Jr., George R. Repaire, Robert W. Scott, Frank A. Shelden, Karl H. Sprick, Leonard G. Strom.

In addition to these there are: Norman Tenneson, Don M. Umphrey, David B. Van Winkle, Douglas A. Vaughan, William A. Ware, Harold T. Weaver, A. S. Wellington, Douglas H. Wright, Henry Zetschok, Paul P. Zinder.

Still more are: Ray Babcock, Vincent E. Diehl, Robert E. Easton, Louis E. Fontaine, Carl W. Horack, David L. Hughes, Russell L. Meredith, George B. Randolph, Edward F. Roskowski, Arthur E. Stultz, Edward M. Verdugo, and William T. Wright.

Side-Lights on Santa Clara Valley Chapter

By Andrew E. Rylander

As far as the California tool engineers are concerned, the Big News was the chartering of Santa Clara Valley—tentatively San Jose—chapter No. 98 of the American Society of Tool Engineers, which took place June 17th at Dinah's Shack, Palo Alto. Incidentally, the "Shack" is a fine restaurant, one of many throughout the Peninsula that attracts epicures from far and wide. It's got "atmosphere."

I got there well ahead of the meeting and coincidentally with fellow Past-Directors Art Lewis and Karl Bues, the latter with a bag of cherries. Really good! From Art, recently returned from a tour through Europe, I got the low-down on conditions across the Big Drink, gay Paree and all. Ay tank Ay go home, too.

By dinner time, there was an overflow crowd of some 180 or more tool engineers and guests, many of whom had to be seated outside of the meeting room and leaving little enough elbow room at that. But, no dampening of enthusiasm; a typical ASTE dinner meeting with its laughter, banter and good fellowship. Felt right at home!

Dinner over, Ch'man pro tem Vince Diehl turned the meeting over to Director Ben Hazewinkel who, in accordance with ASTE procedures, called for a formal election of officers. But, it seems that the members were well satisfied with the incumbents, with the result that the secretary was instructed to cast a unanimous ballot.

Locke of Food Machinery & Chemical, appointed Membership Ch'man of Santa Clara Valley.

My chore was to present the chairman's pin to Vince Diehl, and right there I played my usual luck—as I found out later. All the rest of the gang were beautifully photographed—good enough to put 'em in the movies! So was I, but on a pic that faded out.

During introduction of visitors, Ted Rohrer of Golden Gate chapter stole the show with a congratulatory speech that, lacking nothing of sincerity, would have done credit to the parliamentary cadences of Bob Douglas. At that, Ted had brought along about all of the past and present G.G. officers and a considerable contingent besides. So why shouldn't the spirit of mortal have been proud? Good going, Ted!

One thing in particular I'd like to comment on because it is so typical of Vince Diehl's innate courtesy. That is, the presentation of a Tool Engineer's Handbook and his personal membership pin to Bill Ware, first pro tem secretary of the chapter who, since removed to Los Angeles, had worked hard and diligently toward its organization. If Vince ever becomes king, he won't be the king who forgets.

Speaker of the evening was J. J. McGrann, of the Timken Roller Bearing Co., Tube Division, who, because of the lateness of the hour, threw his talk into overdrive and cut corners besides. Well, I know how that is. At that, he

Les Hawes, national public relations chairman, swears in Santa Clara Valley officers at the charter meeting. From left: Chairman V. E. Diehl, First Vice Chairman W. C. Lanyon, Second Vice Chairman E. F. Roskowski, Secretary G. B. Randolph and Treasurer Robert Harper.

After presentation of the charter by Director Hazewinkel, Les Hawes—Ch'man, Nat'l Public Relations Com'tee—swore in the officers. Ralph Chrissie, Ch'man of Los Angeles chapter, presented a gavel on behalf of his home chapter, whereupon Vince Diehl discarded the ketchup bottle with which he had previously maintained law and order. In turn, Wayne Ewing, 1st V.C. of the Nat'l Membership Com'tee, presented a membership kit to Donald

put his talk over admirably and left us with considerable more know-how on the quality and advantages of graphitic steels. In passing, I might add that Timken steels once pulled me out of a bad hole.

Everything considered, the new chapter got off to a fine start, being particularly encouraged by a congratulatory message from Andy Clark, Ch'man of the Nat'l Membership Com'tee. No.

(Continued on next page)

Worcester Chapter Tours Lapointe Plant

Worcester—A conducted tour of the Lapointe Machine Tool Co., Hudson, Mass., was held June 3 by members of Worcester's ASTE chapter. More than 100 persons, including several visitors from the Boston chapter, studied the plant operations as they were explained by appointed guides.

The visitation was followed by a smorgasbord arranged by John E. Rotchford, program chairman, and a regular meeting conducted by Chairman E. Roland Ljungquist. Both were held at the Marlboro Country Club.

Joseph P. Crosby, vice president of Lapointe and second vice president of the Society, gave a short talk on the ASTE area meeting in Dallas.

The technical speaker was Kenneth N. Macomber, chief service engineer of Lapointe, and Worcester ASTE member, who discussed the history and art of broaching.

Films were shown of broaching operations in the manufacture of jet propulsion engines and of the unusual fixtures developed for holding work. The fixtures make it possible, for example, to hold the large compressor rotors of jet engines at compound angles, thus replacing 12 fixed angle blocks.

Defense plants have given the fixtures credit for having solved the serious problem of practical production, the cost of which would otherwise have been prohibitive.

Items of interest pertaining to professional engineering were discussed at the June meeting of ASTE's national professional engineering committee. Shown here, seated, from left, are: V. Gallichotte, Golden Gate chapter; L. B. Bellamy, Society president; Charles M. Smillie, member of Detroit chapter and head of the committee; J. P. Crosby, second vice president; H. G. Heimann, Milwaukee. Standing: A. F. Moosbrugger, Piedmont; H. E. Conrad, executive secretary; Prof. L. E. Doyle, Chicago chapter; H. L. Alietti, Long Island chapter and Marvin Bunting, national headquarters staff.

Fabricating Presses Topic of T. W. Bannon

Chicago—Members of the Student Section of Chicago's ASTE chapter heard Thomas W. Bannon, chief engineer, Clearing Machine Corp., at the May meeting held at Allied Institute of Technology. More than 150 members and guests were present for the program on fabricating presses.

Two new officers were elected at the business session. C. W. Demboski was named secretary and Mr. Compton was elected treasurer.

Rylander's Side-Lights on Santa Clara Valley

(Continued from page 81)

98 should become an important member of the ASTE family.

One thing the new chapter is to be congratulated on is the support it has won from area industries—Westinghouse Electric, Food Machinery & Chemical Corp'n, Hiller Helicopter Corp., and many other important industries. Present were considerable groups from Dalmo-Victor Corp., Schlage Lock Co., Marchant Calculating Mach. Co., and other larger and smaller concerns along the Valley, Peninsula and Bay Areas.

From one thing to another, had a pleasant visit from Showman Joe Friel & Mrs. during the month, Joe having found his way to my *hacienda* (?) from a map I gave him during the ASTE Show in Chicago. Also among visitors—and this should be of interest to ASTE members employed at Mechanical Engineering Service, Detroit—was Meredith Grubb, from whom I had news of *auld acquaintances*. I may be gone, but not forgotten; as Ed Berry put it, I'm "only a couple of hills away."

At date of writing—June 25—I've just had news of the passing of John Eacock, for the past several years office manager at Society HQ. To me, Jack had been a friend, and admired as a conscientious worker. Well, a lot of us are getting to an age where these partings are to be expected, and its nice to have pleasant memories of men with whom we have been closely associated both vocationally and socially. For John Eacock, then, turn down an empty glass. And to Mrs. Eacock, my sincere sympathies in her bereavement.

Obituaries

John S. Eacock

John S. Eacock, 57, office manager at the Society's national headquarters in Detroit, died June 21 following a short illness. Mr. Eacock was named to the ASTE post in the fall of 1948.

Born in Indianapolis, he received his accounting training from International Correspondence Schools, LaSalle Extension University and Wayne University. He had been associated in accounting and administrative positions with several engineering and manufacturing firms before joining the ASTE staff.

He was a member of Controllers Institute of America, Inc., National Association of Cost Accountants, National Association of Foreman and several fraternal organizations.

Albert D. Forbes

Albert D. Forbes, charter chairman of the Boston Chapter, died on May 16. He had been in the employ of the General Electric Co. in various capacities for more than 35 years.

John K. Turvene

John K. Turvene, 35, past chairman of the North Texas chapter of ASTE, died June 1 in a Dallas hospital after an illness of several months.

Mr. Turven was manager of the Texas division of Holister Coil Spring Mfg. Co. A native of Dayton, Ohio, he was transferred to Dallas from Los Angeles in 1946.

He had been active in civic and church affairs and was a member of the American Society for Quality Control and the American Society for Metals.

Roy R. Hoefer

Roy R. Hoefer, member of the Pittsburgh ASTE chapter, died suddenly on May 2 from a heart attack. He was a tool engineer with the National Tube Div., United States Steel Corp., at the time of his death.

Before moving to Pittsburgh in 1951, Mr. Hoefer owned the Hoefer Engr. Co. in Chicago where he served for three years as chairman of the constitution and by-laws committee of the Chicago chapter.

News in Metalworking . . .

EXPLAINS SHORTAGES IN INDUSTRIAL DIAMONDS

The stepped-up use of new, super-hard metals for civilian and military products and for machine tools has made the role of industrial diamonds increasingly important. Many of these metals require the close tolerance grinding which only wheels made of actual diamond powder affords or which require precision grinding with wheels that must be dressed and trued with industrial diamonds.

"This spiralling demand plus increased production costs and not the alleged 'planned shortages' on the part of Industrial Distributors Ltd., have been responsible for the present scarcity and high prices of diamond powder for grinding wheels. Industrial distributes 95 percent of the world's industrial diamonds." The statements were made recently by L. H. Metzger, president of Super-Cut Inc., on his return from Johannesburg where he was authorized by E. T. S. Brown, a director of Industrial, to speak in behalf of the diamond company, on this particular point.

Mr. Metzger attended a symposium held at the suggestion of Industrial Distributors, which is headed by Sir Ernest Oppenheimer, and his statements were made on the basis of conversations with, or on public utterances by, Sir Ernest.

These statements included assurance that there are no industrial diamonds available other than the present monthly shipments which constitute the present total monthly production. However, this situation is looking up. Industrial and its producing affiliates are being urged to make every effort to increase supply and reduce costs. Oppenheimer interests already have spent $7,500,000 to expand and improve production facilities at one mine and will spend additional millions on others. In addition, new equipment and methods of mining have increased the recovery at the improved mine from one carat per each 5 tons of material handled to one carat for each 3½ tons.

ENGINEERS SPECIALTIES ADOPTS NEW NAME

Optical Gaging Products, Inc. is the name The Engineers Specialties Div. of Universal Engraving and Colorplate Co. adopted officially as of June 1. At the same time the organization was moved to 26 Forbes St., Rochester, N. Y.

According to company spokesman, personnel and company representatives will remain unchanged.

150TH YEAR SPURS DUPONT CELEBRATION

On the same site on the banks of Brandywine Creek where a century and a half ago the first E. I. DuPont de Nemours & Company powder mills were located, a marker was dedicated as part of that firm's celebration of the date. The marker was formed by one of two huge millstones, weighing about seven tons each, ordered from France by the founder of the company. Originally, its function was to grind, by water power, the ingredients of black powder.

About 7,000 spectators, including representatives from the company's 71 plants and Wilmington offices and retired employees, were on hand for the ceremonies which included a simple historical dramatic prologue and addresses by company officials, among them Henry B. duPont, great-great-grandson of the founder.

An anniversary book, "DuPont—The Autobiography of An American Enterprise," traces the company's growth and role as it has affected the nation.

"We started to make money when we installed our first Moore Jig Borer in 1936" SAYS AL STAUBER, MANAGING PARTNER, DACO MACHINE & TOOL COMPANY

Some were pretty small: All were very accurate...Die and Stripper for piercing 47 holes in stainless steel shutter stamping were jig bored and jig ground by Daco on Moore equipment. Hole location was within ±0.0002; hole sizes were held within ±0.0001.

Now Daco, one of nation's best-equipped tool and die shops, has 5 Moore Jig Borers and 3 Moore Jig Grinders

The toolroom which has at its disposal modern methods for fast and accurate hole location will take complex work in stride—*and make money*. Al Stauber proved that when he installed, in 1936, his first Moore Jig Borer at Daco Machine & Tool Company, Brooklyn.

Soon a jig grinder took its place alongside. Daco then had the perfect hole location partnership—the jig borer to locate and bore the hole accurately... and the jig grinder to relocate and grind it after hardening (and also grind contours).

Now famous for instruments and instrument tooling, Daco uses 5 Moore Jig Borers and 3 Moore Jig Grinders for 90% of its hole locating and a good percentage of its contour grinding operations. All have been operated at least 50 hours weekly the last four years; several, through two shifts. Daco also has two Moore Panto-Crush Wheel Dressers and a Moore Die Flipper.

You can prepare for tomorrow's competition *by writing today* for literature describing Moore Jig Borers and Jig Grinders.

Moore Special Tool Company, Inc., 732 **Union Ave., Bridgeport 7, Connecticut**

ADD MOORE TOOLS TO YOUR TOOLROOM

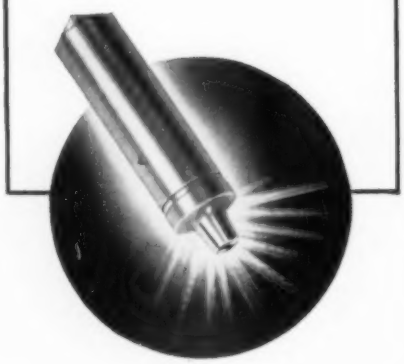
JIG BORERS • JIG GRINDERS • PANTO-CRUSH WHEEL DRESSERS • DIE FLIPPERS • MOTORIZED CENTERS • HOLE LOCATION ACCESSORIES

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-83

New!

KOEBELITE
TRADE · MARK

Cemented Diamond Particles



More efficient than conventional single diamond tools —with MUCH LONGER LIFE.

•

Reduces set-up time—increases production.

•

Now ready and proven: Koebelite CDP (Cemented Diamond Particles) Tool for Ex-Cell-O and J & L Thread Grinders, pictured above.

•

KOEBEL DIAMOND TOOL COMPANY

9456 GRINNELL AVENUE
DETROIT 13, MICH.

FIRST to give diamond users the advantage of diamonds set in powdered metal.

INDICATE A-8-84

LELAND ELECTRIC BECOMES AMF DIVISION

Leland Electric Company, major manufacturer of electric motors, has been made a division of American Machine & Foundry Company. Purchase of Leland, with its plants in Dayton, Ohio and Guelph, Ontario, brings AMF's plant total to 16.

According to the announcement made by Morehead Patterson, AMF board chairman and president, the transaction involved the exchange of all of Leland's properties and assets for a maximum of 191,474 shares of AMF common stock which includes an adjustment for a stock dividend of 2½ percent paid by AMF on June 14, less an undetermined number of shares resulting from dissents.

According to Mr. Patterson, present management of Leland will continue as before.

STRESS ANALYSIS COURSES OFFERED TO ENGINEERS

Experimental stress analysis will be the subject of a two-week course offered to industry by Purdue University August 4 to 15. Particular points to be covered in the course will include basic fundamentals as well as the latest techniques in the use of strain gages, brittle lacquer coatings and the application of photoelasticity to locate defects in manufactured products. Designed particularly for practicing engineers, it will enable them, through both lecture and laboratory work, to become better acquainted with the latest developments in the field.

Prof. Erwin O. Stitz and Robert M. Gray, of Purdue's experimental stress analysis laboratory in the School of Civil Engineering and Engineering Mechanics, will teach the course.

APEX SMELTING GOES WEST

Apex Smelting Company has acquired 20 acres within the Los Angeles industrial area where it will construct a plant which is expected to be producing aluminum alloys by late fall this year.

According to company announcement, the facility will be engineered to include the latest developments in equipment for melting and material handling. When completed it also will be in production for magnesium alloys and zinc base die cast alloys.

ACME STEEL EXPANDS

A $160,000 warehouse at Montreal is under way by Acme Steel Company of Canada, Ltd. This is the second major expansion step made by the Canadian subsidiary of Acme Steel Company of Chicago. Earlier construction of a $980,000 manufacturing plant at Scarborough, Ontario was announced.

TRUING DEVICE IDEA WINS $1000 PRIZE

The largest single prize award in Jones & Lamson history has been presented to Iring G. Millay of J&L's special tool department for his idea for a "Multiform Wheel Truing Device".

Essence of the suggestion, for which Mr. Millay received $1,000, is a comparatively small dressing device that can be adapted to many types of grinding machines in order to dress grinding wheels to almost any desired form quickly and accurately. With this device, as many as fifteen forms can be plunge-ground at a time while formerly they had to be done singly. The truing instrument is put in place and the wheel trued on the chuck. The work is then placed on the chuck. And, it is estimated, the eleven forms now being ground at once will take less time than one piece would have taken previously. At the same time it is said there would be considerable cost savings on reorder jobs because of the reduced grinding time. In addition there is the possibility that a much broader application can be developed than the present known ones.

Mr. Millay, who has been with J&L since early 1935, was first employed in the die department and later as a foreman in the chaser grinding department. For the past eight years, he has been employed in his present capacity in the special tool department.

Mr. Millay's suggestion was awarded the prize following one of the company's routine suggestion-box reviews. A regular Suggestion Committee, composed of two employees and two management men, reviews employee suggestions each week. These are reviewed anonymously and voted upon. If reaction is favorable, time study determines savings to be effected or accuracy or output to be improved. Then the amount of the award is determined, still on an anonymous basis.

PROFESSORS' SEMINAR TO STUDY INSTRUMENTATION

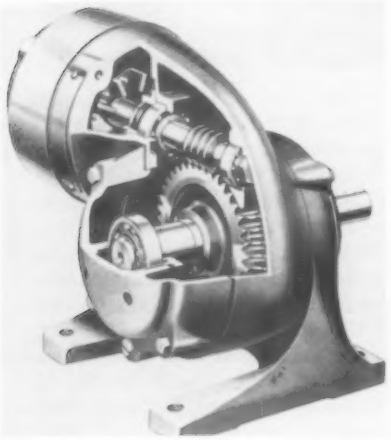
The third annual seminar in industrial instrumentation will be held for professors of engineering in Philadelphia August 18 to 22, it was announced by the Industrial Division of the Minneapolis-Honeywell Regulator Co.

It is aimed at familiarizing faculties of engineering schools with recent advancements in industrial processes and attendant development of automatic instrumentation. According to M. J. Ladden, training supervisor for the company's Brown Instruments division, this phase of engineering is covered only on a broad basis in the conventional curriculum. The program also will include discussions of mutual problems of engineering colleges and the instrument industry.

Tools of Today . . . .

Worm-Gear Motor

A line of low speed right-angle worm-gear motors has been placed in production by U. S. Motors, P. O. Box 2058, Los Angeles 54, California. Introduced as type GW Syncrogear, the design presents numerous exclusive features not heretofore available in low-speed motors. Types GW motors incorporate a cantilever design to protect gear alignment. Mounting stresses are absorbed by a single unit pyramidal



base with spread-eagle feet. The gear and motor housing are free from distortion. It embodies splash lubrication, a hardened and ground worm, leakproof oil seal and asbestos-protected windings. It has self-locking brake action. The parabolic contour of the motor housing gives the unit a pleasing appearance. This new motor is built in speed ranges from 20 to 155 rpm and gear ratios up to 58:1. Horsepower ranges from ¼ to 3. It is made in both three-phase and single phase. The GW Syncrogear can be installed horizontally or upright and can be provided with a footless flange mounting. Other modifications provide variable speed, splashproof design and total enclosure.

T-8-851

Pressure Tester

Announcement has been made of a new pressure tester that will directly and accurately indicate the actual pressure in pounds of ram on work in presses.

It has broad application for determining weights and total pounds pressure on all types of presses. It is most valuable in insuring quality control against inaccurate ram pressures. It can be used either vertically or horizontally.

The self-contained hydraulic unit is accurately calibrated and heavy-duty rugged construction makes for long life.

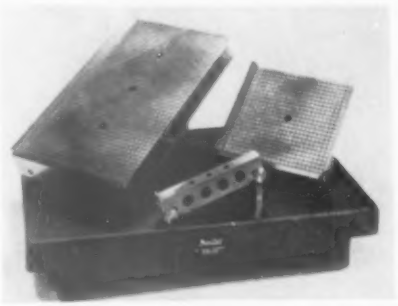
It is made in three sizes, 0 to 10,000 lb; 0 to 50,000 lb; 0 to 100,000 lb. Special pressures over 100,000 pounds are available on special order. For information, write to Studebaker Machine Co., 1212 S. 9th Ave., Maywood, Ill.

T-8-852

Sine Plates

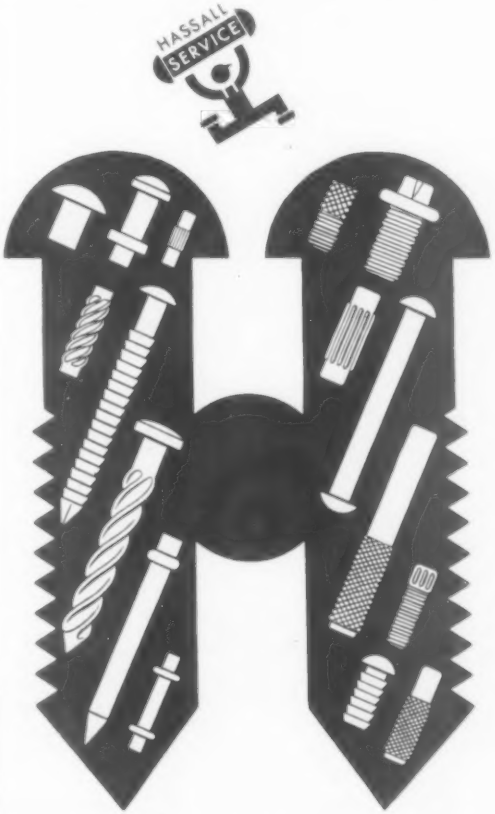
Sine plates, affording appreciably larger working surfaces for precision checking of angles on large workpieces, are now being manufactured by DoAll. The sine plates are available in 5- and 10-in. sizes. Top area of the 5-in. plate is 6x6 in.; top area of the 10-in. plate is 7x12 in.

The broad working surfaces of the sine plates permit difficult checking jobs to be handled with ease. For example, the various degrees of angle of a sine chuck can be most accurately checked on these sine plates. For precise checking of compound angles the plates are ideal. To make such checks, the 5-in. plate can be used in conjunction with another 5-in. plate or with a 10-in. plate. Also, either the 5- or the 10-in. plate can be used with a 5-in. sine bar.



A feature of the sine plates is the three-point base arrangement. Two short cylinders, spaced 5¼ in. apart between centers, are used in place of the single-piece base cylinder commonly employed in sine fixtures. This arrangement minimizes errors which commonly occur with sine fixtures using the long cylinders. The base is sufficiently wide so that the danger of tipping is reduced and the needed stability is obtained for making rapid checks of large angle castings, tools, dies and other pieces.

T-8-853



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THE CHARLES L. JARVIS CO., MIDDLETOWN IN CONNECTICUT

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-86

Surface Grinder

British Industries Corp., 164 Duane St., New York 13, is the representative in the United States for Churchill Machine Tool Co., Ltd. of Broadheath, Manchester, England, and is now offering for early delivery their O-B hydraulic surface grinder.

The cross feed graduations are in 0.0001-in. divisions and the vertical adjustment of wheel head is 0.0001-in. divisions. All controls are so located that they are within easy reach of the operator. This machine is designed throughout to ensure maximum rigidity and maintenance of alignment. It has variable hydraulic table traverse up to 60 feet per minute; cross feed up to 0.150 in. at each stroke. The Nitralloy steel grinding wheel spindle has a Churchill patented hydrauto automatic bearing control. **T-8-861**

Carbide Cutter

A carbide tipped milling cutter has been developed that combines advantages of the solid and the inserted blade types. Interchangeable blades are seated on the periphery of the cutter body with the tail end seated against an abutment in the body. Cutting forces are transmitted to the body through this abutment. Heat-treated body bound screws accurately locate the blades against the body abutment through a conical seat.

The bodies can be bladed for straight slotting, alternate blade slotting or half side milling. Changes in rake and shear angles required for cutting various materials are accomplished by a quick change of the rapid mounting blades. Blade changes cannot damage the bodies since there are no wedges, serrated surfaces and body slots. Body distortions resulting from tip brazing repairs are eliminated.

Standard stock sizes now available in plain and side milling cutters are in widths of ½ and ¾ in. ranging in diameter from three to eight inches.

For further information, write Millet Div., Kraus Design, Inc., 950 Exchange St., Rochester 8. **T-8-862**

Extension Chuck

This extension chuck eliminates soldering brazing and the purchasing of special length drills that are easily broken and cannot be readily replaced. Due to the patented features, regular straight shank drills can be inserted from the rear of chuck when a drill breaks. This feature facilitates replacement of broken drills.

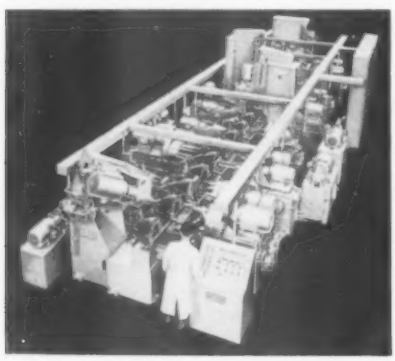
The main feature of this invention is that a series of chucks are manufactured for holding drills of various sizes and at the same time are interchangeable for use on one extension rod.

Since Little Beaver extension rods are manufactured from high-quality drill rod, they are easily straightened. Made by Corydon M. Johnson Co., Bethpage, Long Island. **T-8-871**

Transfer Machine

An automatic 22-station transfer machine for performing a sequence of varied operations on a cast iron clutch housing has been designed and built by Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit 7.

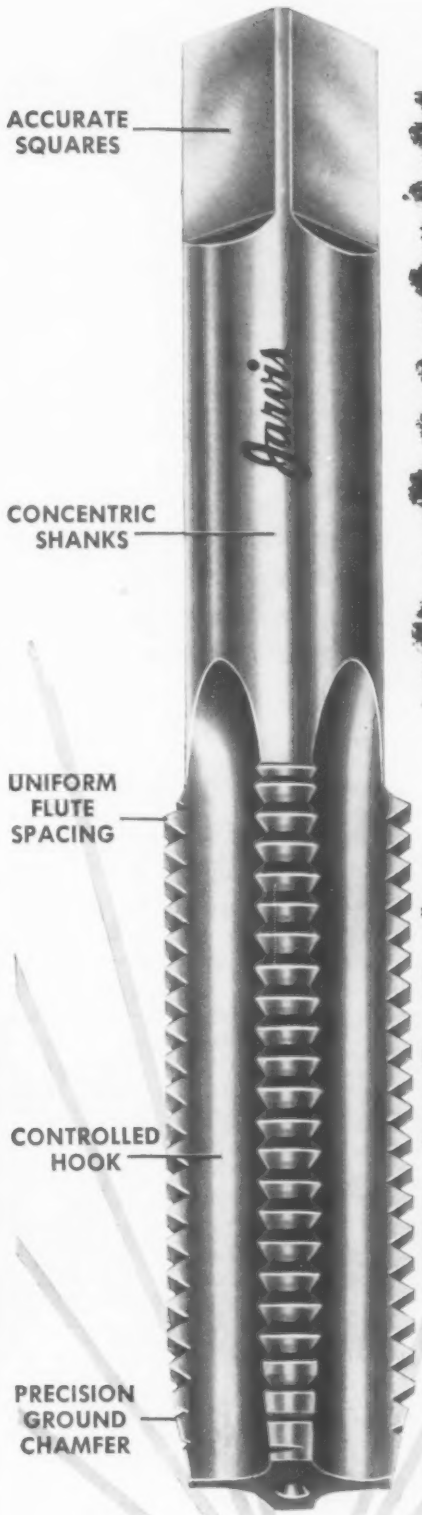
Operations include drilling, rough and finish boring, milling, sawing, tapping, spotfacing, counterboring, and chamfering—total of 37 operations on 105 surfaces or holes of various dimensions. Production rate is 124 cycles an hour at 80 percent efficiency.



There are several unusual features in this machine. An unusual tooling feature is in that in Station 1, a two-in. diameter breather hole is trepanned from the solid casting and finish-bored with one tool.

At Stations 8 and 9 normal positioning of milling cutters and transfer rails would have resulted in interference. The problem was solved by dropping a section of the rails through cam action linked to the milling units.

At Station 16, the workpiece is turned 90 deg and transferred to another set of rails for further processing in the new position, without being permitted to vibrate or move out of correct location during the transfer movement. **T-8-872**



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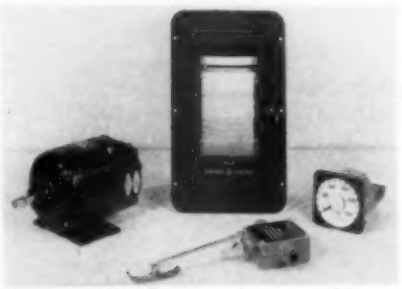
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-87

Tachometer Kits

Tachometer kits, containing all the components necessary to provide instantaneous and permanent records of machine performance at a central location, have been announced by the General Electric Co.'s Meter and Instrument Dept.

Central location of the kits' recording equipment eliminates time-consuming production-line trips by supervisory personnel, permitting up-to-the-minute checks of operating equipment. A permanent recording feature aids preventive maintenance scheduling, and prevents excessive manufacturing losses by



automatically shutting down machinery in case of breakdowns.

Four kits are available in the new line. A typical installation would include a d-c tachometer generator, a tachometer indicator, a switchboard-type tachometer recorder, and where a continuous web of material is produced, a web-break detector. Audible or visual alarm systems are optional accessories.

Kits are particularly suited for use in the continuous process industries such as paper, textile, rubber, glass and steel and aluminum rolling. T-8-881

Contact Wheel

A contact wheel with spare rubber tires that cut wheel replacement costs in half has been announced by the Chicago Rubber Co., 2620 Clybourn Ave., Chicago. Designated the Universal type T-54 contact wheel, it was developed in conjunction with the leading manufacturers of coated abrasive products.

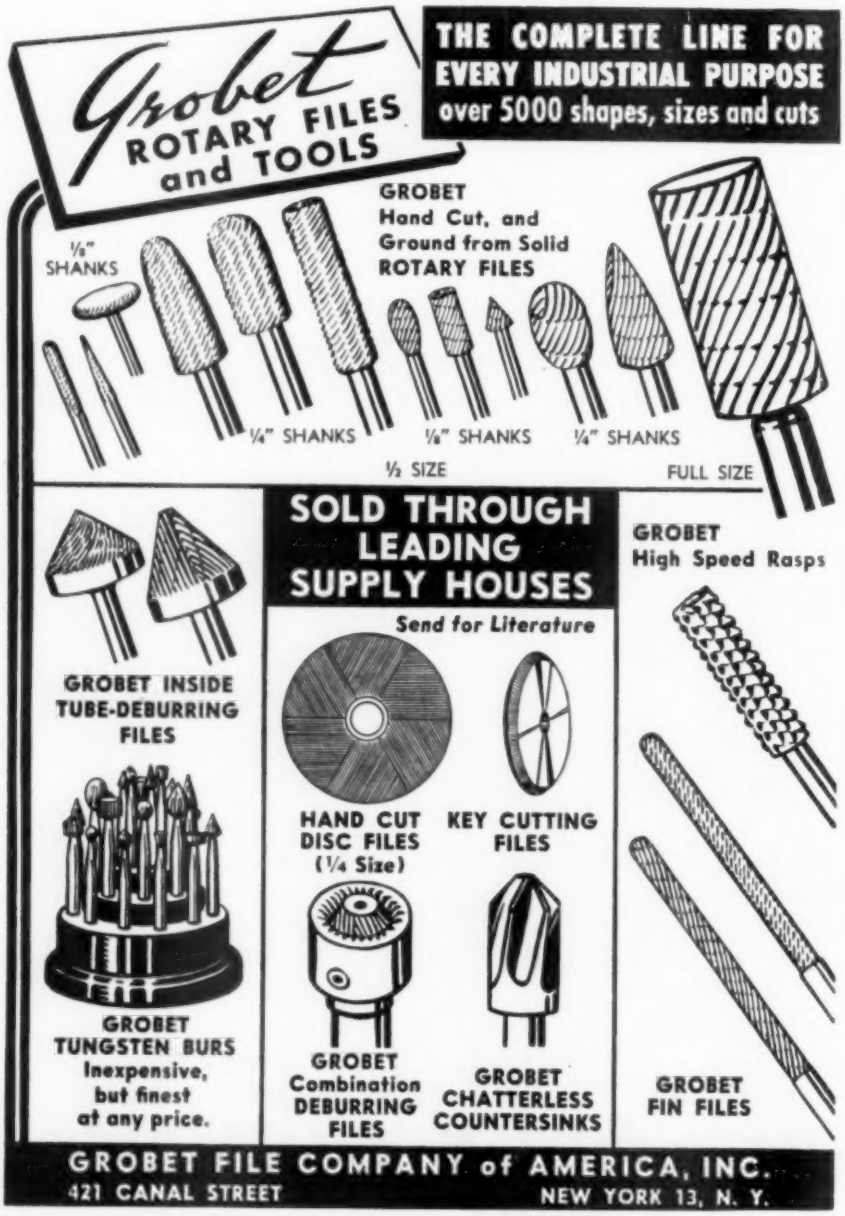
Previously it was necessary to replace the entire contact wheel after continuous use. However, with the new wheel it is necessary only to replace the rubber tire. This can be done in a matter of a few minutes and at savings of approximately 50 percent compared to the cost of a new contact wheel.

The wheel is expected to find wide use in both large and small shops since it will make it both possible and economical to have a complete assortment of the tires on hand with a wide variety of surfaces for different grinding operations.

The new wheel consists basically of two parts: a balanced T-54 rubber tire vulcanized on a steel frame, or rim, for rigidity and support, a split, universal hub machined from aluminum. The two sides of the hub are joined together by Allen screws, locking the tire in place.

Tires are available in standard face widths of one inch to six inches with fractional widths available on special order, while durometers range from 10 to 90 in either plain surfaces or a variety of slot designs for the particular grinding operation. T-8-882

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION



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Are you interested in saving up to 50% in your inspection time, also extending for many years the useful life of expensive gage blocks?

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INDICATE A-8-89-1

Drill Stop

Scully-Jones & Co., 1915 So. Rockwell St., Chicago 8, announces a drill stop used on turret lathes, drill presses and radial drills for operations like center drilling, drilling and reaming where close control of depth is required. On these operations, or wherever a quick change arrangement is

used in one station for sequence operations, uniform hole depth can be held by using this drill stop. It provides a positive stop which ends guesswork and reduces rejects.

A threaded lock bushing provides quick and accurate adjustment of the stop collar. To insert or remove cutting tools, simply loosen set screw and slip the stop collar from the threaded shank. A quarter-turn of the set screw forces the bushing against the shank threads for a positive lock. **T-8-891**

Center Finder

A battery-operated center finder that lights up when the point desired is located, has been developed, and is being manufactured by Art-Mil Machine & Mfg., Inc., Columbus, Ohio.

Designed for use with milling machines, lathes, jig borers and drill presses where precision work is essential, the Art-Mil center finder or light wiggler, provides accuracy to within 0.0001 in. when used to locate working points or in slot and hole centering.

A small, compact device for the tool box or the toolroom, the light wiggler operates on a standard one-cell battery similar to those used in flashlights attached to key chains. The manufacturer reports this new center finder can be used to center and locate bores, for truing deep holes, locating spindle centers, and to set recesses inside bores. In each instance, when it makes contact with the workpiece, it automatically lights up to eliminate guesswork and lessen eyestrain. The light wiggler can be used as a comparator on a surface gage when equipped with a special holder, can be used to pick up dimensions by contact with height gage without use of feelers, and can be used as a warning stop where close tolerance is necessary.

The center finder is furnished with an extra long offset, point and ball stem, can be used regardless of runout of spindle. Standard stems may also be used with it. **T-8-892**

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Mr. M. V. Mattson, Empl. Mgr., Dept. TE-

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INDICATE A-8-89-2

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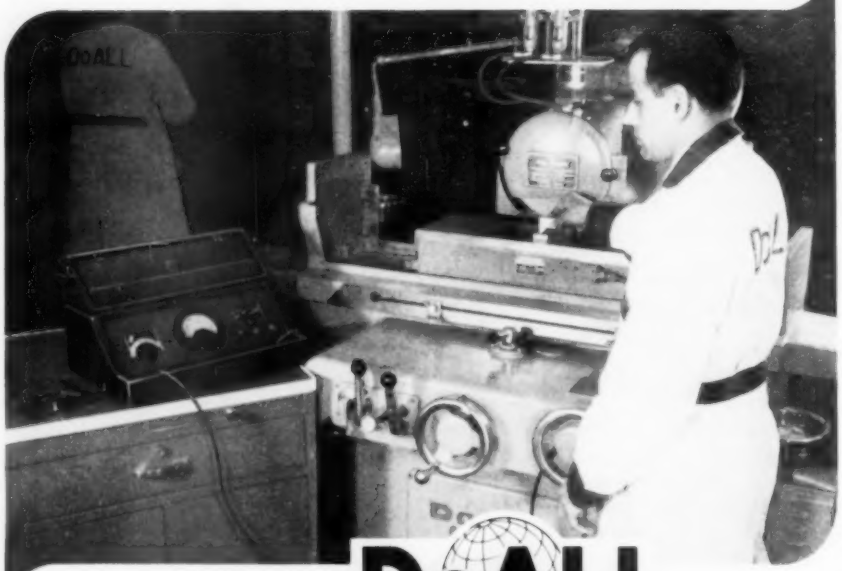


because DoALL uses the PROFILOMETER

The DoALL Company of Des Plaines, Illinois, world famous manufacturer of machine tools, gages and cutting tools, gives customers an exclusive analysis of the precision and dependability of each DoALL Precision Surface Grinder.

To do this, DoALL relies on the Profilometer as the final check made on every grinder manufactured.

Rigid tests provide that each DoALL grinder before completion must grind a sample block of steel using a standard 46-grit wheel and have the resulting surface finish measured by the Profilometer. This Profilometer test on the steel block must register a finish of less than 10 microinches r.m.s.! These records of surface finish with the actual steel block are then attached to each grinder prior to shipment—thus assuring purchasers of the exceptional precision of each grinder.

As a shop instrument the Profilometer is widely being used throughout all industry where surface measurement is needed in machining, grinding or other sizing and finishing operations.

The Profilometer provides the fastest, simplest and most versatile means of obtaining dependable roughness ratings for all surfaces from a fraction of a microinch to 1000 microinches r.m.s.

In your plant, too, the Profilometer can offer exceptional advantages as an all important shop tool.

To learn how the Profilometer can help cut costs in your production, write today for these free bulletins.

Profilometer is a registered trade name.

MICROMETRICAL MANUFACTURING COMPANY
formerly PHYSICISTS RESEARCH COMPANY
Instrument Manufacturers

ANN ARBOR 10 MICHIGAN

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-90

Angle-Head Drill

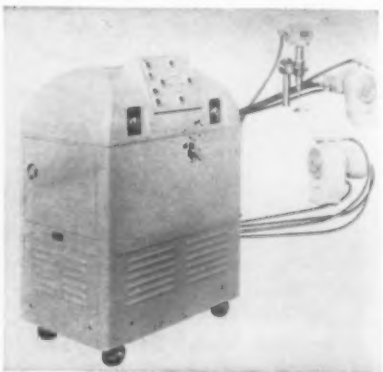
Described as the lightest of all ½-in. angle drills, Mall Tool Co. specialists have worked out the special angle design of the drilling head on this air-powered tool to allow better access to confined, hard-to-get-at places.

The small, compact angle-head permits drilling in unusually close quarters. Another feature of the tool is the facility with which the angle-head can be swiveled to any position relative to the throttle by simply loosening a single nut. The result is more all-around maneuverability and general operating flexibility.

Inside the aluminum alloy housing of this Mall ½-in. pneumatic angle drill is one of the most powerful air motors ever designed, producing high power in relation to air consumption, as well as efficient operation at low pressure. A built-in regulator allows for variable speed ranges, while proper lubrication results from a built-in automatic oiler that eliminates the need for line oiling. Mall Tool Co., 7740 S. Chicago Ave., Chicago 19. **T-8-901**

Duplicating Machine

A device for use with mills or lathes makes possible automatic duplication of machined internal and external profiles and contours on a production basis.



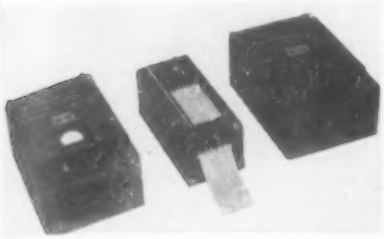
Tracer Control Co., 595 East Ten Mile Road, Hazel Park, Mich., are national distributors for the unit which is known as the Lodge and Shipley duplicator.

The duplicator accurately controls two feeds of the machine for reproducing from a templet or original model or workpiece difficult compound curves as well as 90-deg shoulders.

It acts as an attachment to the machine and does not have to be removed for use of the machine on other work without interference. The duplicator can be moved from machine to machine as the need arises and allows any machone with which it is used to operate at normal feeds and speeds for milling, turning, boring and shaping. **T-8-902**

Welding Analyzer

A direct-writing welding analyzer now records single-phase and three-phase resistance welding machine variables. Welding current and electrode force are measured and recorded simultaneously, and show the important squeeze, weld, hold, and off-time intervals. The analyzer also records the



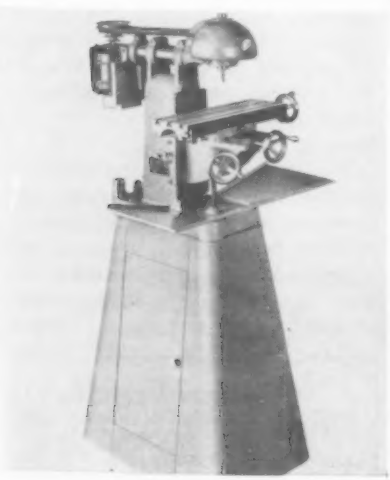
small 180-cycle-per-second component present in the three-phase welding machine current when ignitron rectifiers are used. The welding engineer can adjust the welding machine as the measurements are being made, due to the immediate availability of the information on the direct writing oscillograph.

This welding analyzer, model BL-213, consists of a modified model BL-202 dual-channel oscillograph, a modified model BL-932 d-c amplifier, and model BL-320 universal amplifier. The modifications in particular enable the analyzer to record at the frequency of 180 cycles per second for three-phase timing purposes. The operating variables of resistance spot, projection, and seam welding machines can also be accurately recorded.

For further information, write The Brush Development Co., Instrument Div., 51 E. 3405 Perkins Avenue, Cleveland 14.

Pedestal Mill

The Benchmaster miller, long supplied for bench use, is now available with a new pedestal, rolled from sheet steel. The pedestal is table height,

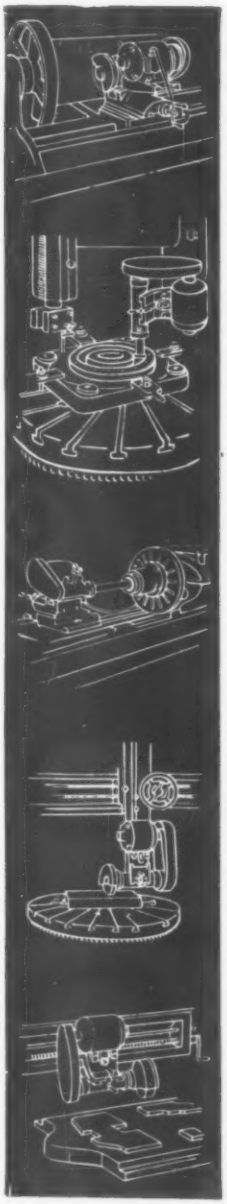


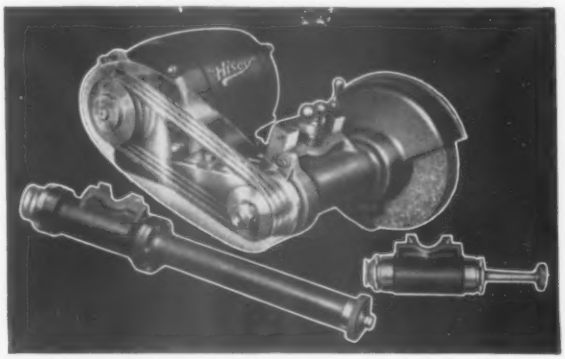
matches the base dimensions of the mill and flares out at the foot to provide a substantial, secure mounting. Inside area accommodates the Benchmaster M-21 coolant system or can be used for storage area. Dimensions are as follows: top 10½ x 18 in.; base 18 x 26 in.; overall height 30 in.; door size 11½ x 22 in.

For more cleanliness in working with coolant, an additional new accessory is available. The all-steel splash tray is designed to fit the standard Benchmaster base, diverting coolant to the sump return. Width and length are such that protection is afforded over full table extensions, both longitudinally and transversely. Edges of the tray are rolled and beaded for extra strength and elimination of sharp corners. Flanges are provided for fastening to the base. The splash tray may be used with both horizontal and vertical Benchmaster milling machines.

For further information, write the Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif. **T-8-912**

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION





YOUR LATHE

is a precision Grinder!

Either internal or external—your boring mill, too—and planer and other machine tools in your shop, are now capable of precision grinding of rolls, surface plates, bearings, journals, mandrels, cutters, etc. They merely require a HISEY Wide Range Precision Grinder attached to their regular tool holding fixture.

Built in a number of sizes and types, they are adaptable for production work as well as the thousand and one odd grinding jobs which crop up in every shop and tool room.

The V-Belt drive affords the most efficient and economical speed and permits rapid speed changes as required.

Driven by constant speed motor, a steady, uniform speed is maintained as required for best results.

Catalog 72 EA on Request

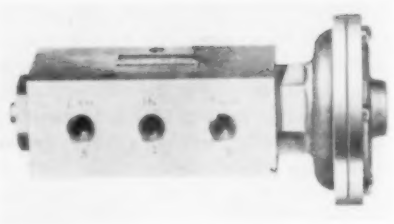
Hisey THE HISEY-WOLF MACHINE CO. CINCINNATI 8, OHIO

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-91

Diaphragm Valve

Introduced by C. N. Hunt & Son, Inc., Salem, Ohio, the Quick-As-Wink diaphragm-operated spring return single plunger valve is for use when only low-pressure air is available for the pilot control. These valves can be operated with instrument air at pressures of from 12 to 35 psi on the diaphragm and consequently are well suited for use in development and research laboratories, and all types of industrial and commercial applications.

These valves feature sturdy construction, simplicity in design and extreme ease of operation. All parts are carefully balanced. The valve housing is aluminum. The stainless steel



plunger is hollow with precision-placed radial ports. The spring return is placed under the diaphragm push plate, permitting open-end exhaust if desired.

The manufacturer reports that the improved design prolongs the life of the packing and valve parts, reducing repairs and maintenance to a minimum, and that the valves can be completely disassembled and reassembled in a few minutes without disturbing the main piping.

Furnished tapped for either ⅛- or ¼-in. pipe connection, in 2-way, 3-way, double 2-way, 4-way, and 5-way designs for use with air, oil or water at line pressures up to 125 psi—also vacuum—at normal temperatures (not exceeding 150 deg F.). T-8-921

Time Delay Switch

A time delay switch recently introduced by Pneu-Trol Devices, Inc., 1438 North Keating Ave., Chicago is provided with a wide variety of thrust linkages for either right or left downthrust, upthrust or horizontal thrust actuation. The switch increases the application and widens the use of air and hydraulic cylinder power in controlling machine movements by providing controlled time dwell at positive stops on either end of the cylinder movement. Pneu-Trol time delay switches offer a practical hydraulic

method and low-cost answer to the need for accurately controlled-time dwell and are making possible automatic control of hundreds of machine and tool motions never before considered practicable.

The new switches can be furnished to dwell in any 20-to-1 ratio from a minimum of ¼ second to a maximum of 60 seconds. Changing of the liquid viscosity in the dashpot provides variation in the dwell ratios. Time delay adjustments within the 20 to 1 ratio are quickly made by turning the knurled adjusting screw on the switch housing.

The switch is also available in explosion proof and vapor-sealed types. Compact in size, Pneu-Trol time delay switches can be easily mounted at the cylinder where their relatively small size offers no obstruction or interference to machine movement. T-8-922

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

"MARVEL" HAS always had the edge

MARVEL High-Speed-Edge Blades assure Faster, more Accurate cutting with proven Economy and complete Safety. Only the MARVEL is a composite blade with a high speed steel cutting edge electrically welded to an exceptionally tough, strong alloy steel body.

The High-Speed-Edge does the cutting while the alloy back with hardened eyes, carries the load. Blade tensions up to 300% higher than those possible with ordinary blades are recommended. This greater tension is confined to the cutting or leading edge by the location of pin holes (exclusive MARVEL design feature) and cannot be overcome by work resistance. Heavier feeds and greater speeds are practical without "run out."

With greater accuracy, higher production and lower cost per cut, come the extra dividend of Safety, for MARVEL High-Speed-Edge Hack Saw Blades are Positively Unbreakable—*they will not shatter.*

Ask your local MARVEL distributor (see classified phone book) to help you modernize your metal sawing with MARVEL High-Speed-Edge Blades. They cost no more than ordinary blades.

1. High-speed-steel cutting edge.
2. Tough unbreakable alloy steel body with hardened eyes.

1. & 2. Integrally welded to make a fast-cutting, long lasting composite blade that is *positively unbreakable.*

MARVEL Metal Cutting SAWS
Better Machines-Better Blades
ARMSTRONG-BLUM MFG. CO.
"The Hack Saw People"
5700 Bloomingdale Ave. Chicago 39, U.S.A.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-92

Swivel Joints

Development of a standardized line of high pressure hydraulic swivel joints for general industrial, military, and aircraft use with tubing or pipe is announced by Aeroquip Mfg. Co., Dept. J-34, 1801 Winnemac Ave., Chicago 40.

The particular advantage of the design of the joints is that they are self-aligning, which simplifies and speeds up installation when working with tubing or pipe where it is difficult to attain perfect alignment. The self-aligning feature is also of importance in service as a result of eliminating binding and minimizing wear.

The joints are produced in four different styles with straight or angle connections for use with ¼-, ⅜-, ½- or ⅝-in. tubing or equivalent size pipe. All styles and sizes are offered with a choice of thread connections: AN, Industrial Ermeto, or standard pipe threads. Pressure ratings are 3000 psi hydraulic with steel or aluminum casing and stainless steel ball. Depending on service, temperatures ranging from -100 to + 500 deg F can be accommodated. **T-8-931**

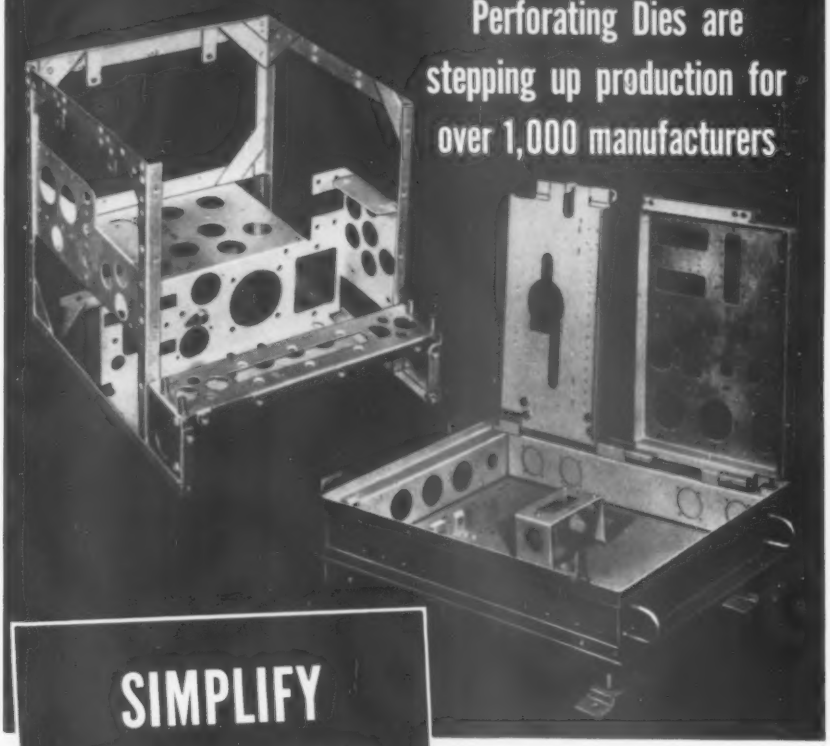
Air Friction Clutch

The Flex-Disc air friction clutch for heavy-duty clutch applications is announced by the Cardwell Mfg. Co., Inc., Clutch Div., Wichita, Kansas.

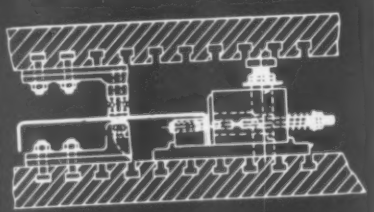
The Flex-Disc clutch claims to solve the problems of present-day air friction clutches. The manufacturer lists the following advantages of the Flex-Disc clutch: no moving parts to wear; never requires adjustment; will not burn out, clog up or become affected by oil or water; longer friction surface life due to uniform plate pressures and air-cooled operation; compact, alloy steel construction gives light weight and requires less shaft space.

It is available in single and multiple tube and plate design and is made in a full range of capacities and sizes to fit every air friction clutch application. Air friction brakes of the same general design, either spring-engaged and air-released, or air-engaged and spring-released, are also available. **T-8-932**

Whistler Adjustable and Magnetic Perforating Dies are stepping up production for over 1,000 manufacturers



SIMPLIFY COMPLICATED PIERCING OPERATIONS



Use this HU-50 90° Perforating Unit on the same job with other Whistler Dies ... often saves extra press operations.

USE WHISTLER Adjustable and Magnetic Dies for perforating, notching and slotting sheet metals ... fast, accurate and cost cutting. Complicated patterns can be set up quickly. Hole arrangements can be changed in the press...without waiting and at no extra cost. New HU-50 units, that pierce at 90° angle, can be used in conjunction with standard perforating equipment. Fewer press operations are necessary.

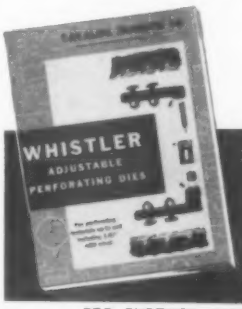
Re-use the same dies in different arrangements on many jobs. Punches and dies are interchangeable.

Whistler Adjustable Dies can be used in practically every type press. Standard sizes and shapes of punches and dies available up to 3 inches. Special sizes and shapes to order.

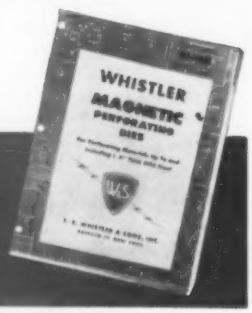
S. B. WHISTLER & SONS, Inc.

744 Military Road

Buffalo 23, New York



For prices and application data on this modern way to speed production and cut unit costs, write for these illustrated Whistler catalogs.



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30 DAY DELIVERY

O-M CYLINDERS
AIR HYDRAULIC WATER

MORE POWER In less space
At **LESS COST**

O-M is *All* Cylinder—packing more *power* per square inch than any other type! No tie rods or bulky end caps, saves ⅓ in installation space. In full range of sizes from 1½" to 8" bores. All machined steel with bearing bronze. Parts and mounting brackets fully interchangeable. Special design standard parts applicable to almost all "custom" installations.

ORTMAN MILLER
MACHINE CO.
Hammond, Indiana

FREE NEW CATALOG 28, diagram-packed pages of specifications, parts listing and other information.

FREE TEMPLATES Complete set. Shows all cylinders and mounting brackets. ½ or ¼ scale.

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1210 150th St., Hammond, Indiana

At no cost or obligation . . .

- ☐ Send me your new, complete catalog.
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Name_____
Firm_____
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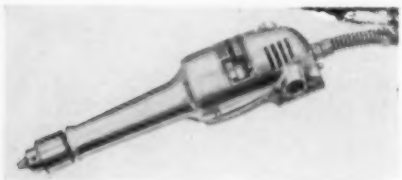
MAIL COUPON TODAY!
INDICATE A-8-94-1

Hand Grinders

Three hand grinders for use with mounted wheels and points have been announced by Skilsaw, Inc., 5033 Elston Ave., Chicago 30. These grinders meet the need of tool and die departments, pattern shops, designers, modelmakers and professional craftsmen for an extremely light-weight, maneuverable and powerful utility grinder.



Model 137 is equipped with a 5/32-in. capacity geared chuck and has a speed of 20,000 rpm. Model 146 also has a speed of 20,000 rpm but comes with ⅛- and ¼-in. collet chucks. Model 148 has an ultra high speed of 36,000 rpm and ⅛- and ¼-in. collet chucks.

Models 137 and 146 are designed for use with shank accessories of 1¾-in. and smaller diameters. Model 148 has a capacity of one in. and smaller shank accessories. All are less than 10 in. in length and weigh approximately two pounds. **T-8-941**

Electrical Relay

The type CO protective relay, a slow-speed overcurrent type with inverse or very inverse time characteristics, is now available from the Westinghouse Electric Corp. Used principally for protection of transmission and distribution lines, the relays are available in one of three ranges—0.5 to 2.5 amps, 2 to 6 amps, or 4 to 12 amps.

Accurate timing is provided by adjustable magnetic plugs in the newly-designed E element electromagnet. Accurate pick-up at tap value of current for all disk positions is provided by two independent adjustments. Accurate adjustment of the damping torque of the permanent magnet can be made by means of a keeper screw without moving the magnet.

Since the relay can be changed in the field from one time characteristic to the other, it has considerable flexibility. Further, it is mechanically and electrically interchangeable with the old type CO relay.

Metal-to-metal contact between tap terminal and tap plate, as provided by the positive action tap block with self-positioning taps, makes the contact system of the new relay reliable. The one-piece, die-cast frame and the cast alnico magnet add to its reliability, and the non-geared design reduces maintenance needs. **T-8-942**

MEYCO
CARBIDE INSERTED DRILL JIG BUSHINGS

*PATENTED

☆ Combining the best features of steel and carbide—here is the answer to increased production and to tough drilling problems: MEYCO Carbide Inserted Drill Jig Bushings.

MEYCO bushings last as long as solid carbide bushings in most cases and cost a great deal less—they will increase the life of drill jigs, fixtures, drills and reamers—they will maintain accuracy for a much longer period of time—they will increase production, save you money in machine-down time, lost man-hours and less spoilage.

MEYCO bushings are made to A.S.A. Standards in Headless Press Fit, Head Press Fit and Fixed Renewable Types. MEYCO Bushings can also be adapted to many special applications—write for fully informative catalog No. 13 today.

Manufacturers of precision tools since 1888

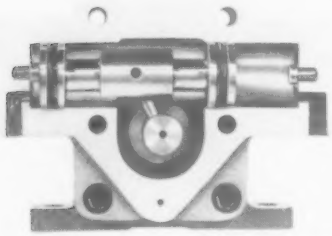
W. F. MEYERS CO., INC.
BEDFORD, INDIANA

INDICATE A-8-94-2

Power Valve

Ledeen Mfg. Co., Los Angeles, announces the POV power-operated valve, available in six sizes, suitable for air, oil and water operation with option of finger, cam, toe or solenoid pilot controls.

Ledeen power-operated valves are designed to serve a variety of purposes where hand- or foot-operated valves cannot be used, such as: remote control, where the operation must be a distance from the valve; automatic operation, where the movement of some part of a mechanism must start the valve to create another movement; reciprocating service, where the cylinder must move continuously back and forth; safety, where a failure of electric power or line pressure must reverse the valve.

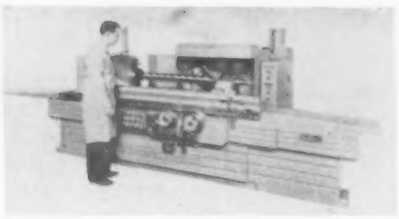


This power-operated valve is essentially a standard four-way valve, but the rotation of the disc is accomplished by means of a piston moved by the operating fluid pressure of the main line, and controlled by small pilot valves suitably located and actuated. Applying pressure through the pilot on one end of the piston forces it to move ahead and rotates the valve disc to forward position. Applying pressure on the opposite end moves the piston back and rotates the disc to reverse position. **T-8-951**

Thread Grinder

The style 36 Ex-Cell-O precision thread grinder is a large-capacity machine for grinding threads, worms and other forms. It has the flexibility required for toolroom work, the accuracy that precision thread and gage work requires and automatic cycles that speed production work. It will grind single or multiple threads, left or right hand, in any pitch from one to 128 threads per inch. It can be used with single- or multiple-rib grinding wheels. An attachment for grinding accurate internal threads also is available. Several types of diamond dressers may be used on the style 36 thread grinder, the choice being determined primarily by the type of thread or form to be ground.

The relation of work spindle speed to table feed can be easily changed to



produce various leads. This is accomplished by means of change gears. Most standard leads can be obtained by the use of a set of gears furnished with the machine.

Right- or left-hand threads may be ground simply by positioning a lever. Setting the lever to a neutral position permits indexing the work spindle for grinding multiple-start threads and worms. An automatic indexing attachment also is available.

Automatic functions of the thread grinder include feed to finish size, wheel dressing, work size compensation for dressing, resumption of the grinding cycle after dressing, backlash compensation, control of the coolant flow, lubrication, and retracting the wheel at the end of the grinding cycle. For further information, write the Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32. **T-8-952**

SAVE

set-up time . . .

Cut true holes in pilot runs with the NEW

WAUKESHA

Floating

QUICK-CHANGE CHUCK

The WAUKESHA Floating Quick-Change Chuck. Stocked in Morse Taper sizes 1 through 5. Fabricated entirely of heat treated tool steel.

Your set-up time is greatly reduced with the WAUKESHA Quick-Change Chuck because correct alignment of your cutting tool is not required. The built-in Floating Holder gives you instant and positive parallel alignment up to .030" at any point within 360°. No trial and error in your pilot or production runs.

Changing tools is quick and easy. Simply lift a locking ring which releases two steel driving balls — seat the new tool — snap the ring down — and you're ready to go. No springs to weaken or break.

Cut your shop costs. Order this efficient "two-in-one" tool from WAUKESHA — today.

Other Money Saving WAUKESHA Tools

WAUKESHA manufactures a complete range of adjustable, inserted blade cutting tools: reamers, spade drills and special tools for individual requirements. You save money with WAUKESHA Tools for you replace only the blades; the tool bodies last for years.

Like your safety razor — you replace only the blades in WAUKESHA Adjustable, Inserted Blade Tools.

Send for the *new*, complete, illustrated WAUKESHA Tool Co. catalogue. Gives full specifications and prices. A post card will bring it promptly. Write today.

WAUKESHA TOOL CO.

1428 Arcadian Ave.
WAUKESHA, WIS.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-95

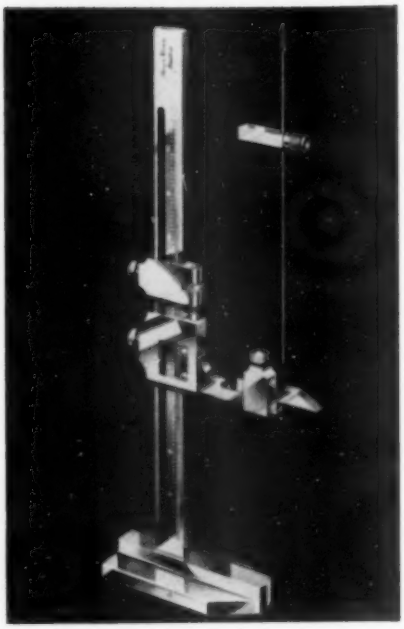
Height Gage

Transocean Trading Co. announces the introduction of a 10-in. toolmaker's height gage, manufactured by Benson Verniers, Ltd., England.

Made of tool steel, properly hardened and lapped, this high-quality precision instrument provides extremely accurate vertical measurements. The heavy base assures maximum balance and the beam of 5/16-in. thickness makes this instrument a strong, rigid and long-wearing item. Adjustable vernier plate for wear adjustment, depth rod and offset scribers are available with the gage.

This tool comes in a velvet-lined leather case. Other size instruments, plus vernier calipers, test gages and precision instruments, are available from Transocean Trading Co., 6453 Santa Monica Blvd., Los Angeles 38.

T-8-961



Diamond Wheel Lap

Life of cutting tools can be increased from three to six times and sharp, finish-lapped cutting edges obtained through the use of a new method of wheel lapping developed recently by Penn Scientific Products Co., 5941 Alma St., Philadelphia 24.

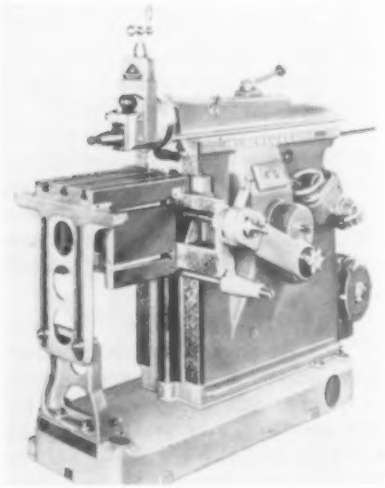
Spectrum diamond lapping compound in any desired grit size, produced from pure virgin diamond, is applied to special Spectrum lapping wheels. The Spectrum wheels are made from materials that retain their shape and wear indefinitely and are interchangeable on all tool grinders. Providing a simple inexpensive method for obtaining cooler cutting, longer lasting tools, Spectrum methods are excellent substitutes for costly diamond wheels.

Spectrum diamond lapping compounds for use on the wheels can be obtained in all standard grit sizes and sub-sieve sizes. Each Spectrum grit size is identified by a color of both tube and compound.

T-8-962

Lathes

The Hercules shapers with V-ram and 16-in. stroke are high-speed machines, designed and built to meet the most exacting requirements of modern machine shop practice and equally well-suited to production as to toolroom work.



There is automatic pressure lubrication to gear box, bull gear main bearing, rocker arm slide block and ram guide ways. Surface of work table is 15½ x 10½ in.

Cutting speed indicator is six speeds, 26-152 strokes per minute. Standard equipment includes 7-in. swivel vise with jaw opening of 8 in.

Complete illustrated catalog giving all technical data on the Hercules shapers available from Parker Machine Co., Inc., 158 Pioneer St., Brooklyn 31, N.Y.

T-8-963

Hammond
OF KALAMAZOO
CARBIDE TOOL
AND
CHIP BREAKER GRINDERS

Save
TIME
TOOLS
WHEELS

CB-77 Chip Breaker and Diamond Finishing Grinder

WD-10 Wet or Dry 10" Carbide Tool Grinder

14-WD Wet or Dry 14" Carbide Tool Grinder

Hammond Carbide Tool Grinders will soon pay for themselves thru greater wheel economy, longer tool life and FASTER grinding. They relieve toolroom bottlenecks and step up production. Write for Carbide Grinder Catalog.

Hammond Machinery Builders INC

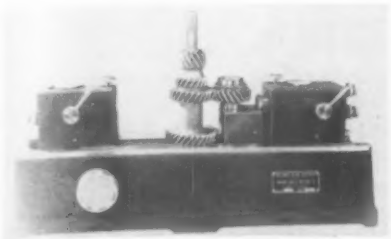
1661 DOUGLAS AVE. • KALAMAZOO, MICH.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-96

Helix Adapter

An adapter and an attachment have been developed which materially enhance the value of the Orlandi gear checker, used in every stage of production from blank to finished gear to improve quality and reduce scrap.

The adapter simplifies set-up for checking helix angle to the point of practically eliminating mathematical



computations. The size gage block required for set-up is determined by simply taking the sine of the helix from the trigonometry table, subtracting ½ the diameter of the adapter pin and adding the net result to the "constant," etched on the machine.

A rolling attachment for use with a master gear makes possible the rapid check of pitch diameter and concentricity accurate to 0.0001 in. With this attachment, backlash can also be checked with mating gears or master gears.

Manufacturer of the machine is the Orlandi Gear and Machine Co., 16195 Meyers Road, Detroit 27. **T-8-971**

Dial Test Indicator

The design of the Lufkin universal dial test indicator results in greater accuracy, durability, and adaptability. Made by the Lufkin Rule Co., Saginaw, Mich., the indicator is so designed that it is lightweight, but very substantial. The one-piece construction of the base and shank results in an assembly that will not be loosened, even under severe use. Since the mechanism is mounted on the one-piece base and shank, a rigid and accurate alignment of the moving parts is provided which is independent of the case. The simplified mechanism excludes the customary train of gears, resulting in a smoother and more sensitive action. The jeweled thrust bearing also increases the smoothness of operation and insures accuracy and longer life. All greasing and oiling are eliminated.

As the improved hole attachment screws directly into the base, no extra overhanging or supporting arms are necessary. The outside knurled ring (bezel) contains the dial and is adjustable so that the zero can be set to any position in relation to the pointer.

T-8-972

Production News

ABOUT *Lusol*.. —THE ALL-CHEMICAL METAL-WORKING SOLUTION

FROM F. E. ANDERSON OIL COMPANY • PORTLAND, CONNECTICUT

4 TOOLS NOW DO THE WORK OF 18 WITH LUSOL IN THEIR MONARCH LATHES

This motor shaft is tough on tools. 18 a day were required until a 25:1 Lusol solution was put in each Monarch Lathe. Now they use only 4 tools per day for the same production and same fine finish.

Unusual? Not at all! Reports of greatly increased tool life, faster machining and better finishes are the usual thing where Lusol is at work. Plant managers tell us that, when they put Lusol in one machine, they soon have other operators asking for it. They like Lusol.

users say*

A TOOL BUILDER—"Drill lands and flats stay sharp on deep drilling with Lusol, where we used to have a lot of trouble."

A ROLL GRINDER—"Eight hours grinding time, required for finishing four diameters in a step roll, was cut to six hours by changing to Lusol. And they improved the finish."

A GEAR MAKER—"Only four pieces were formerly produced before milling cutters had to be ground. The solution smoked badly. After changing to Lusol, 8 and 9 pieces per cutter are obtained, and the work remains cool."

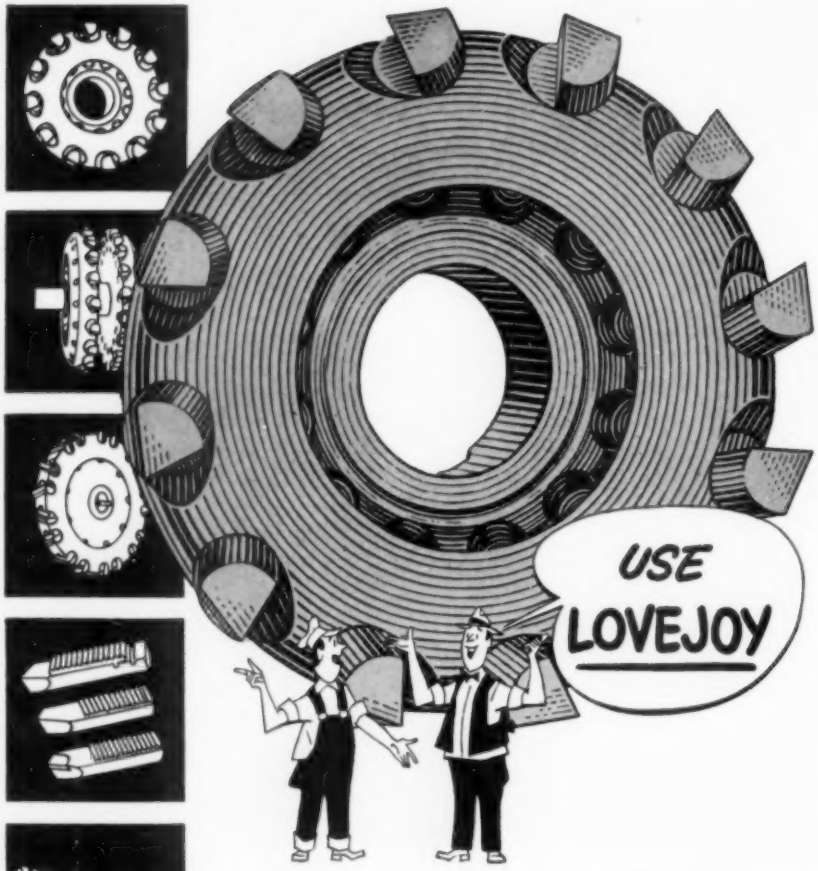
A DIESEL ENGINE BUILDER—"Two Minster punch presses automatically feed steel strip, blank and pierce pole-piece laminations for electrical generators. A small stream of Lusol flows onto the strip as it enters the dies. Used to smoke up the place, but there's none now, and the parts come out clean."

(*Case histories of Lusol at work)

FREE BOOK

Get complete facts about Lusol by writing for this 20-page booklet. It contains information on machine cleaning, maintenance of Lusol solutions, elimination of dermatitis and odor in machines, plus many case histories of Lusol at work. Write F. E. Anderson Oil Company, 213, Portland, Conn.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-97



...the word from the wise in milling cutter circles

The modern Lovejoy line of inserted-tooth milling cutters are ordered and reordered on the basis of performance. Proof? . . . our first customers are still with us after 30 years of satisfaction.

The modern Lovejoy line has never been more complete. Improved new designs, both standard and special, are coming constantly from our large engineering staff.

The modern Lovejoy line features the exclusive "positive-locking" device to allow maximum use of each blade and minimum loss in sharpening.

The modern Lovejoy line of milling cutters, boring tools, arbors, flywheels, etc., plus outstanding field service, can help you cut your production costs, just as it has for others.

131 MAIN ST., SPRINGFIELD, VERMONT

WRITE FOR FREE CATALOGS

LOVEJOY TOOL COMPANY, INC.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-98

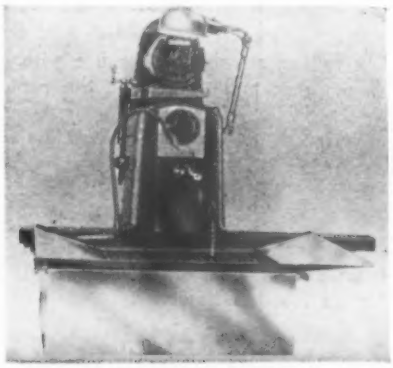
Diesel Engine Pyrometer

A portable diesel engine pyrometer has been announced by The Bristol Co., Waterbury 20, Conn. The new instrument is designed for test purposes and for installations where no permanently mounted pyrometer is available. The thermocouples can be installed in each cylinder and in the main exhaust line. Temperatures can then be checked at any time by inserting the pyrometer prongs into the corresponding receptacles in the terminal head of the thermocouple. The pyrometer, model 4-321 is described in bulletin P1247, which is available on request.

T-8-981

Honing Machine

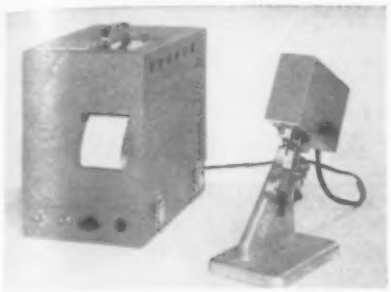
A bench model (model J) honing machine, together with a portable coolant unit is announced by Superior Hone Corp., Elkhart, Ind.



Incorporating the basic features of the Superior floor machine (model AL) the bench model is designed to handle production honing of keyways, spline gears, most broken surfaces and internal finishing operations on a bench set-up basis. It features infinitely variable spindle speeds 400 to 1,000 with no changing of belts; a honing range from 0.185 to 2.500 in. in diameter; no adapters needed; permanent type mandrels that fit spindle with bayonet lock; no tools needed to change mandrels or stones; stones alone bear on workpiece, no metal to metal contact; Dimensions: 25 in. high, 13 in. wide, 16½ in. deep; motor: 1/3 hp, 110-volt, 60-cycle, single phase.

To complement the bench honing machine a portable coolant unit was designed. Range of adjustment and portability make it adaptable to any dry honing machine, and provides rapid conversion from dry to wet operations. Being light, easy to move and mount it can serve several hones in the same shop. It slides in and out of permanent mounting brackets fitted at each machine location. T-8-982

Automatic Chart

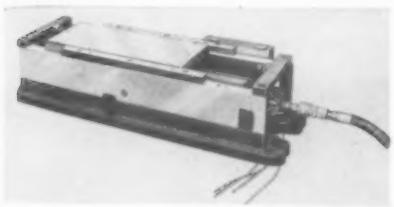


The Johnson Gage Co., Bloomfield, Conn., announced the development of the J-K Qualicorder, an electronic unit designed to provide automatic chart records of product quality. Sizes are charted at individual points in such a manner that statistical analysis may be made immediately following the gaging operation.

When used in conjunction with the Johnson ring-snap and roll-snap thread comparators, human error and judgment are eliminated, thus assuring accurate and positive results. **T-8-991**

Work Feeder

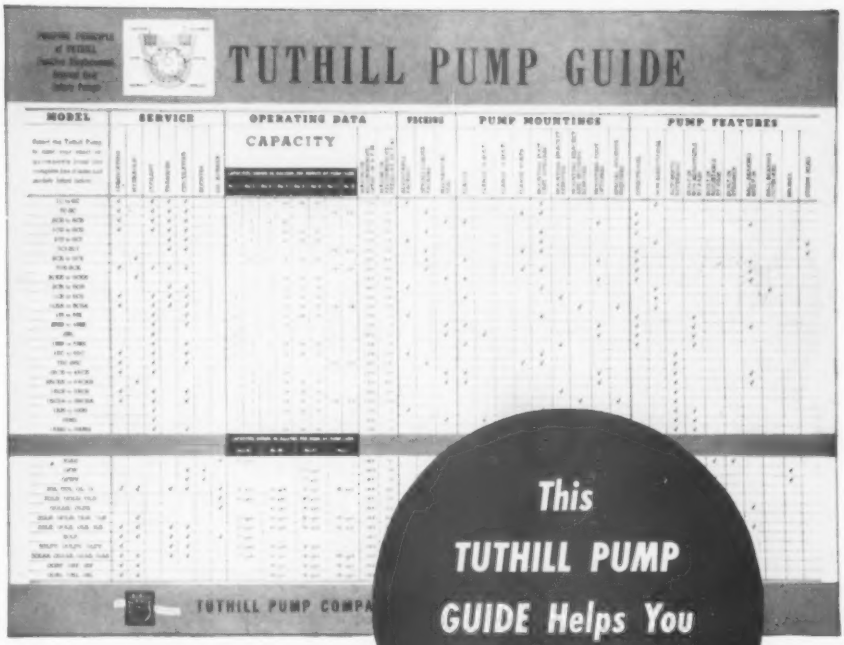
Designed to cut in half idle machine tool time, a two-station electrically controlled, air-powered work feeder, the Transfeed work feeder, is being added to the line of controlled air power devices manufactured by The Bellows Co., 230 West Market St., Akron 9, Ohio.



The feeder consists of a movable, mild steel table top 11/16 in. thick by 5¼ in. wide by 12 in. long, which is guided between hardened and ground dovetail ways. Power for the transverse motion of the table top is supplied by a Bellows BEM 5-60 air motor with a built-in Electroaire valve that is guaranteed against burn-out, yet provides instantaneous power control.

The work feeder has a 6-in. transverse positioning stroke, which allows the operator to load and unload work at one end of the table while the machining operation is taking place at the other end, thus doubling machine tool production. Fixtures for holding the work may be mounted directly to the table top or to oversize table tops. The unit is equipped with adjustable positive stops, for accurate work positioning, that eliminate manual error and resulting spoilage loss. **T-8-992**

NEW EASY WAY TO SELECT THE RIGHT PUMP FOR THE JOB



This TUTHILL PUMP GUIDE Helps You Find the Answer

To save you time and trouble in selecting the pump best-suited to your application, Tuthill engineers have developed this revolutionary new Pump Guide. Here, in one easy-to-use chart, is a volume-full of information on the complete line of Tuthill Pumps.

At a glance, it shows you the services for which each model is built, together with performance characteristics, types of packing, mounting styles and distinctive features that enable you to fit the pump to your need, rather than the need to the pump.

Copies of this helpful guide are now available on request. Write for yours today—there's no obligation.

Tuthill Positive Displacement Pumps serve Industry in Lubrication, Hydraulic, Coolant, Oil Burning, Circulating and Transfer Service.

25th Anniversary TUTHILL PUMPS FOR THE PURPOSE

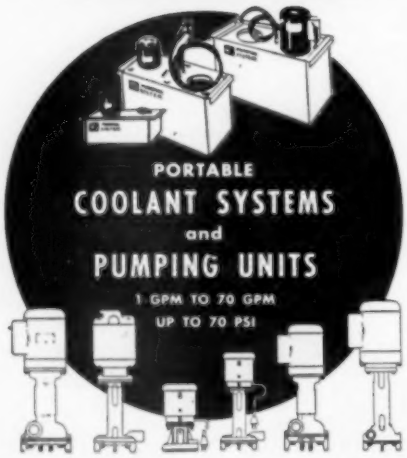
TUTHILL PUMP COMPANY

939 East 95th Street . . . Chicago 19, Illinois

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-99

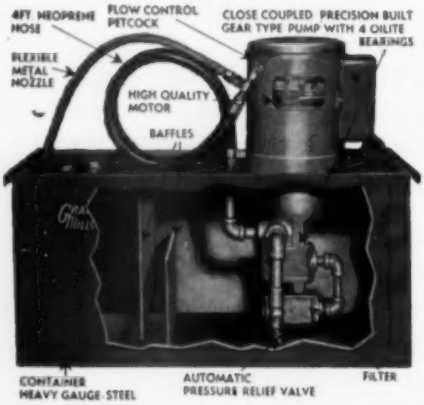
Get More Production from your Machines with

GRAY-MILLS



PROPER application of coolants mean increased production and time and tool savings. You can have these advantages for every machine—small, large, and special—with Graymills Portable Coolant Systems.

They can be installed in a few minutes, are modern in design, and of heavy duty construction with built-in automatic pressure relief valve on gear pumps.



Sturdy high pressure gear models . . . smooth high volume centrifugal types in 1/25 to ½ HP ratings, 1 gal. to 70 g.p.m. with tank capacities from 5 to 38 gals. Also immersion type centrifugal pump and motor units.

MOST INDUSTRIAL DISTRIBUTORS STOCK STANDARD UNITS.

WRITE FOR NEW CATALOG SHOWING SELECTION CHART . . . TELLS THE RIGHT PUMP OR COOLANT SYSTEM FOR THE JOB.

GRAYMILLS CORPORATION
3729 LINCOLN AVENUE • CHICAGO 13

INDICATE A-8-100

Precision Switch

A waterproof, snap-action switch incorporating potted, waterproof terminal leads and a hermetically sealed contact chamber has just been announced by Micro Switch, Freeport, Illinois, a division of Minneapolis-Honeywell Regulator Co.

This 4HS switch makes possible the use of precision, snap-action switches at locations which are subject to immersion, which is of particular value for applications on marine and amphibious craft. The waterproof, hermetically sealed character of this switch makes its use feasible also in many other aircraft, mobile, and marine applications where moisture, dirt, or other conditions of environment could damage, reduce the capacity, or short the terminals of other switches.

The waterproof leads, which are connected to the terminals of this switch, are potted to a high-dielectric plastic which completely seals the terminals and leads. Type 4HS switches are available with leads of any required length, and they can be supplied with waterproof couplings.

The metal case of this switch is sealed at the top by a metal diaphragm, through which the external actuating lever operates. The contact chamber is filled with an inert gas under pressure and sealed. All parts of the switch, including the waterproof embedment, are sturdily constructed to resist damage in applications where ruggedness is essential.

The electrical rating of the type 4HS switch is as follows: 10 amperes inductive load, or 25 amperes resistive load, 28 volts dc; one ampere inducive or resistive load, 125 volts ac. This switch can be had with single-pole, single-throw, or double throw contact arrangement. **T-8-1001**

Reamer Heads

A line of T-J reamers, designed so that one shank is quickly and easily interchanged with a wide range of heads, is announced by The Tomkins-Johnson Co., Jackson, Mich.

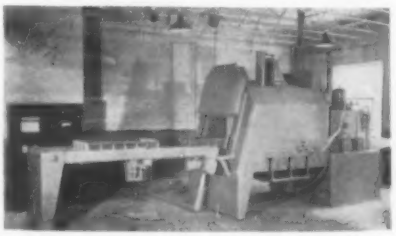
This new feature cuts replacement cost per reamer to less than half because only the reamer head which does the cutting needs replacement. Further savings are possible because the shank material is made from less expensive steel, compared with the requirements of the previous standard one-piece reamer.

The reamers are available in spiral or straight flute. The head has a tapered hole which insures concentricity and a snug fit on the smoothly ground tapered shank. The head can be quickly removed.

Another advantage of the quick-change feature is that it enables the machinist to easily change heads when reaming different metals and thus get maximum performance on the type of metal being cut. Thus, if the work is changed from steel to bronze it is a simple matter to put on a sharp new head and eliminate sticking which occurs when a reamer dulled by steel is used in bronze. **T-8-1002**

Heat-Treating Unit

A medium sized heat-treating unit of 500 lb/ hr capacity for bright heat-treating, carburizing, carbonitriding, martempering, and annealing operations is announced by Ipsen Industries, Inc., Rockford, Ill. The Model T-500 is available for either electric or gas-fired operation. It features automatic sealed atmosphere and temperature control, and automatic transfer of work from heat through the quenching, or cooling cycle. A semi-automatic loader is provided as standard equipment with loading space for two work trays.



The unit is designed with the quench tank direct-connected to the heating chamber, separated by an automatic airdraulic-operated intermediate door. Recessed in the hearth, power-driven endless chains equipped with protruding lugs transfer the work trays from the heating chamber onto an elevator rack over the quench tank. When idle, the section of chain equipped with lugs remains out of the heat zone below the hearth. As the transfer cycle is initiated the cold chain and lugs move into position in contact with the work trays. Since the hot chain moves freely beyond the driving sprockets before load is applied, any excessive stretch or distortion is eliminated, an important feature that insures long service life. **T-8-1003**

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

LITERATURE NUMBER	COMPANY	BULLETIN	DESCRIPTION
A-8-156-2	Ace Drill Bushing Co.	1101-2	Free ACE catalog tells just how to get what you order every time.
A-8-12	Allegheny Ludlum Steel Corp.		New booklet explains how to reduce machining costs and save time and money.
A-8-142	American Broach & Machine Co.	300	Time, labor and machine operation costs outlined in circular.
A-8-116	American Wheelabrator & Equipment Corp.	23	Closer tolerance, stronger bond, brighter appearance, superior lubricant retention qualities assured by Liquamette wet blasting.
A-8-106	W. O. Barnes Co., Inc.		Safety, economy, convenience, dependability all assured in using flexible hack bandsaws.
A-8-157	Bethlehem Steel Co.		Handy color chart shows heat and temper colors.
A-8-11	The Carborundum Co.	6	Metallic cutting off with abrasive wheels discussed in free booklet.
A-8-165-1	Chicago Rivet & Machine Co.		Cut costs . . . Fasten "On the double" with the Chicago "214" double rivet setter. Free catalog.
A-8-166-2	Chicago Tool & Engineering Co.	10	Accuracy, speed, fine construction accented in use of Rotary, index, milling table.
A-8-22	Cincinnati Lathe & Tool Co.	D-121	Save three ways on C-O Cincinnati 3' 7" radial.
A-8-129	Cincinnati Milling Machine Co.	M-1759	Free bulletin gives complete description of Hydroform process, and detailed machine specifications.
A-8-16	Cincinnati Shaper Co.	DN-1 N-5	Greater speed, ease of control and versatility in using shaper.
A-8-171	Crucible Steel Co.		Free "Crucible Tool Steel Selector"—new, simple, handy method of picking the right steel.
A-8-173	Delta Power Tool Div.-Rockwell Mfg. Co.		Catalog describes solutions of machining problems through application of Delta air-powered hydraulic drill unit.
A-8-185	Ex-Cell-O Corp.	35371	Concentricity, hardness, uniformity stressed in bushing catalog.
A-8-26	Gisholt Machine Co.		Free booklet, "Static and Dynamic Balancing" explains greater safety, less wear, better service.
A-8-160-1	J. C. Glenser Co., Inc.	J	Need more production? Glenco Floating Tool Holders.
A-8-164-1	Grobet File Co. of America, Inc.	HC1	Catalog sheet describes Grobet chatterless countersinks.
A-8-96	Hammond Machine Builders		Carbide Grinder catalog tells how to save time and expense.
A-8-134	Hannifin Corp.	150	"Hy-Power" units reduce wheel "runout" to a minimum. Free bulletin.
A-8-138	Haynes Stellite Co.		New booklet describes machinery parts which assure long, satisfactory operation.
A-8-175	Ingersoll-Rand Co.	5099	Bulletin shows line of multiple nut runners built to your specifications
A-8-145	Jones & Lamson Machine Co.		Catalog deals with J & L die heads with ground thread tangent chasers and radial chaser types and dies for Brown & Sharpe machines.

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TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

LITERATURE NUMBER	COMPANY	BULLETIN	DESCRIPTION
A-8-13	The Lapointe Machine Tool Co.	BS-5	Bulletin presents complete information on company's broach sharpeners.
A-8-179	Logan Engineering Co.		Logan lathe and shaper catalog presents complete information with specifications and data.
A-8-132-3	Jas. H. Matthews & Co.	A-1	Hundreds of stock symbol designs offered in bulletin complete with prices.
A-8-160-2	Metal Carbides Corp.	50-C	Catalog discusses Talide metal, its advantages and economy, and the superiority of products made with it.
A-8-94-2	W. F. Meyers Co., Inc.	13	Informative catalog covers Meyco carbide inserted drill jig bushings.
A-8-29	Norton Co.	1683	"The ABC of Surface Grinding", booklet presents facts and special points on this subject.
A-8-168-1	Oakite Products, Inc.		Sixteen-page booklet "8 things to look for when you wash metal by machine" tells what kind of cleaning materials and methods to use on various types metals.
A-8-32	The Ohio Crankshaft Co.		"Typical Results of Tocco Induction Brazing and Soldering" booklet presents case history study.
A-8-108-2	O'Neil-Irwin Mfg. Co.		Forty-page "Die-Less Duplicating" catalog gives details on Di-Acro powershears, benders, brakes, rod parters, and other equipment.
A-8-94-1	Ortman-Miller Machine Co.	28	Diagrams, specifications, parts listing and other pertinent information on O-M cylinders included in illustrated catalog.
A-8-166-1	J. A. Richards Co.	TE-8	Illustrated folder tells about multiform bender pointing out advantages and special features.
A-8-167	Scully-Jones and Co.	18-50	Bulletin carries pertinent facts and data on drill steps.
A-8-110	The Sentry Co.	D-5	Catalog deals with various models industrial furnaces stressing efficiency, economy and other advantages.
A-8-122	Severance Tool Industries, Inc.		"All Star" catalog lists Severance tools pointing out latest improvements and advantages.
A-8-5	Standard Gage Co.	C	Catalog covers explains Standard's Dialiserfor converting adjustable limit snap gages to indicating dial types.
A-8-99	Tuthill Pump Co.		"Tuthill Pump Guide"—easy-to-use chart shows services for each model with its performance characteristics, types of packing, mounting styles and distinctive features.
A-8-113	Vlier Manufacturing Co.	53	Catalog tells about Vlier toggle pads and their main features and advantages.
A-8-127	Wales-Strippit Corp.	DM	Fully illustrated brochure gives detailed particulars on Wales new deluxe model drilling machine stressing precision, versatility, speed and ease of operation.
A-8-104	Ward Leonard Electric Co. Industrial Chrome Div.		Literature presents full story of industrial chrome plating with Chromaster, emphasizing economy.
A-8-95	Waukesha Tool Co.		Catalog. Illustrated catalog gives details of "Quality Cutting Tools" with specifications and prices.
A-8-93	S. B. Whistler & Sons, Inc.	48 and M-48	Brochures give prices and application data on company's lines of adjustable and magnetic perforating dies.

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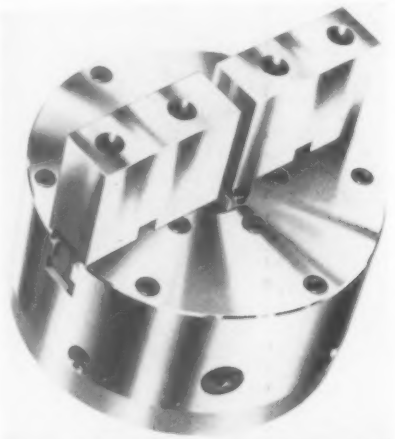
Aviation Chuck

A solution to the problem of chucking irregularly shaped parts is offered by the Buck Ajust-Tru two-jaw aviation chuck. According to the manufacturers it is a satisfactory way to assure accuracy within 0.0005 in. on large as well as small runs of such parts. It rechucks with the same speed as a scroll chuck without need for further adjustment. It eliminates the need and expense of special fixtures and makeshift holding arrangements.



Two design features make such performance possible. The chucks are made with master jaws. Two soft blank top jaws are supplied for machining to hold odd-shaped parts for lathe or drill press. Soft jaws can be hardened after machining to shape, if desired, for long work runs. But the main reason for the performance of the chuck, according to the manufacturers, is the use of the Buck Ajust-Tru principle.

Buck two-jaw aviation chucks are made in 6 and 7-in. diameters. Made by Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich. **T-8-1031**

Water Soluble Coolant

A water soluble coolant for honing has been developed by Pelron Corp., 7740 West 47th St., Lyons, Ill. The product, Pelron #560, facilitates the removal of stock and eliminates many of the customary problems involved in the use of kerosene and sulphur base oils used with kerosene.

The development of a coolant combining the heat-dissipating qualities of water with the cleansing and anti-rust qualities of kerosene was sought. Previous water soluble coolants were found to require increased operating pressures which produced excessive heat. This heat caused out-of-roundness, taper, loading of stones with graphite paste, steam which produced rust and poor stock removal.

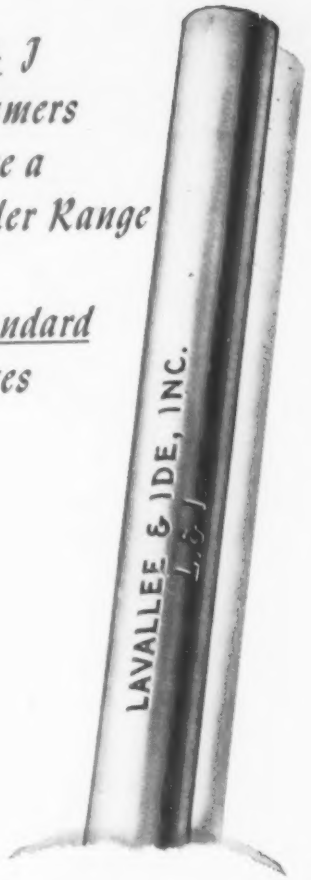
Pelron #560, containing a high percentage of liquid detergent, an extreme pressure agent, and a rust preventive, was found to eliminate the above difficulties. It is used ideally in concentrations of 15-20:1 depending on individual requirements. **T-8-1032**

Radiation Detector

The Ohmart cell, which converts radioactive energy directly into electrical energy, is now available for use with a high-impedance current recorder, according to an announcement by the Ohmart Corp., 2347 Ferguson Road, Cincinnati 38. Utilization of the Ohmart cell, which requires no high-voltage power supply, is said to result in an installation of simplicity of operation. The firm's model RT cell, designed for precision measurement of gamma radiation, may be used for continuous monitoring of ambient radiation such as is encountered in health physics work, or may be used to follow continuous processes where gamma ray activity is present. The cell is built with a centrally located sample well, permitting

use of the cell for the accurate preparation of radioactive dosages for the medical services, since nearly 100 percent geometry is obtained. When connected to the recorder, a permanent record of production is made which not only shows the number of doses prepared, but also records the amount of activity in each dose. The cell may also be used with a number of standard indicating instruments similar to those used for pH measurement. When used with a recording or an indicating instrument signal contacts may be included to sound high or low alarms, or pneumatically or electrically operated control mechanisms may be employed for the automatic control of processes. **T-8-1033**

L & J Reamers have a Wider Range of Standard Sizes



Large Sizes
TO 1½"

Small Sizes
TO .040

L-I

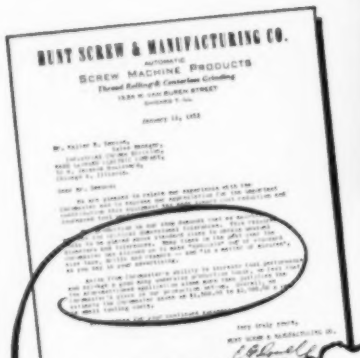
The Reamer Specialists

LAVALLEE & IDE, INC.
CHICOPEE, MASS.

INDICATE A-8-103

"Saves $1,500 to $2,000 in small tool costs"

Here's how one manufacturer cuts costs and increases tool performance by using a Chromaster industrial chrome plating unit right in his own plant.


HUNT SCREW & MANUFACTURING CO.
AUTOMATIC
SCREW MACHINE PRODUCTS

"The production in our shop demands that we maintain extreme and critical dimensional tolerances. This requires tools to be plated above standard sizes to obtain unusual diameters and tolerances. Many times in the past year the Chromaster has allowed us to make 'specials' out of standard size taps, drills and reamers—and 'in a matter of minutes'. Over-all, we estimate the Chromaster saves us $1,500.00 to $2,000.00 a year in small tooling costs."

writes E. G. Dowell, General Manager,
Hunt Screw & Manufacturing Co., Chicago, Ill.

Other users are increasing their production and profits with this simple, fast, low-cost industrial chrome plating process.

A Large Automotive Axle Company Reports:
"Using a Chromasol plated tap with 3½ minutes plating, we are now averaging 6,800 holes per set of taps for banjo housings. This has more than doubled our former 3,000 holes per set of 7/16-14 high-speed commercial ground taps."

An Electric Motor Manufacturer Says:
"We have been able to correct manufacturing errors by Chromasol plating to salvage one hundred electric motor shafts otherwise rejected as undersize."

A Manufacturer of Plumbing Fixtures Says:
"Chromasol plating has increased the life of our 8-32 machine screw tap, used in tapping a plumbing fixture, from 1,000 pieces to 6,000 pieces."

A Pump Manufacturer Says:
"Our deliveries of small pumps for the oil industry have been speeded as much as five days by depositing .0002" to .0005" Chromasol plate on shafts that would otherwise have been scrapped or sent out to a commercial chrome plating company. This operation in one instance permitted a $16,000 pump unit to be put into operation immediately."

There's reason after reason for installing Chromaster in your plant. It can mean dollar savings to you in increased production, minimized set-up and down-time on your machine tool operation. Normal life of your cutting tools and wear parts can be multiplied three to ten times by this amazing new and simplified method of chrome plating. 3½ minutes for the average job. There's a size Chromaster for every shop.

Chromaster

Industrial Chrome Division
Ward Leonard Electric Co.
15 South Street,
Mount Vernon, N. Y.

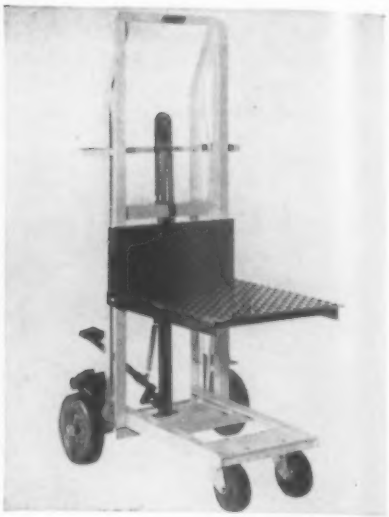
Please send information on industrial chrome plating with Chromaster.

NAME .....
COMPANY .....
ADDRESS .....
CITY ..... ZONE ... STATE .....

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-104

Hydraulic Lift

To ease the movement of heavy loads over rough, uneven floors and other surfaces a hydraulic lift has been introduced by Big Joe Mfg. Co., 184 North Franklin St., Chicago 6. Loads up to 750 pounds are raised or lowered by



pedal pressure. To make horizontal movement of the loaded lift similarly easy, the model 14S platform lift is equipped with heavy duty, dual ball bearing, six-inch diameter swivel casters that take humps, holes or depressions in stride. Aside from slight modifications to accommodate these large casters, the lift is similar to model 14 with three-inch casters. Both have 10-in. solid rubber rear wheels and positive locking safety brakes. **T-8-1041**

Anode Basket

Use of scarce, costly anode metals to the last ounce is made possible by the Forcite anode basket now available to the plating industry through R. O. Hull & Co., Inc., 1308 Parsons Court, Rocky River 16, Ohio.

According to the manufacturer, the anode basket is expressly designed for efficient, complete solution of scrap or ball anode material and may be used in nickel, and copper, lead, and all cyanide baths.

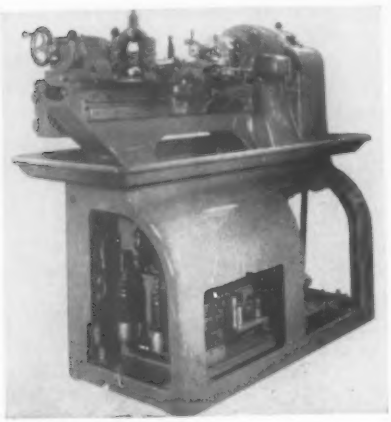
Fabricated from reinforced steel, the basket is completely coated with an inert, insulating material. Its tapered construction is suited to give continuous electrical contact to the anode mass without requiring replacement of contact anodes. Contact is made by perfectly shielded, inert graphite blades the entire depth of the basket and coupled to the anode bars.

Cotton bags are included. Forcite anode baskets are available in either 24 or 30-in. lengths; other lengths are available on special order. **T-8-1042**

Electronic Drive

The Hendey Machine Co., Torrington, Conn., announces an infinitely variable electronic drive for the Hendey 9x24-in tool and gagemaker's lathe. This unit is designed to fit into the base of the lathe as an optional control for the three-hp, d-c, adjustable speed motor.

The electronic drive is of simple design and construction. It contains only two 18-ampere, heavy-duty electronic rectifier tubes in the power circuit, and one smaller rectifier tube in the control circuit. It provides a stepless speed from 25 to 3000 rpm, by potentiometer control of both field and armature of the motor. Extremely close speed control is obtained even under changing load, which is a very important asset in lathe operation. Full torque is obtained at low speeds over the complete armature control range by means of IR compensation.



Due to provisions for extra capacity, and inherent ruggedness, current limiting is unnecessary. A thermal overload relay protects the motor from sustained overloads. The unit is unusually quiet during operation under load.

Dynamic braking accomplishes a full stop from maximum speed in approximately 1½ seconds. Starting, stopping or reversing from preset speeds is accomplished smoothly and rapidly even when set at 3000 rpm.

The electronic drive unit requires 220 or 440 volts, single-phase, 60-cycle current (550 volts, 60 cycles, optional). The electronic rectifier tubes are warranted for 3000 hours at full capacity. Since these tubes operate normally well below rated capacity in the drive, a much greater life can be expected.

T-8-1051

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Add to the known advantages of socket screws, the extra strength and accurate forming that results from Kaufman Process manufacture—and you have *extra values without extra cost.* By this efficient *double extrusion* method, steel qualities are actually *improved.* With modern heat treatment added, Cleveland Socket Screws are *extra tough.* And the true hex sockets, formed in one operation, are clean all the way to the bottom with sharp corners that give firm purchase to the key. It pays you to specify and buy Cleveland Socket Head Screws.

CLEVELAND *Top Quality* FASTENERS

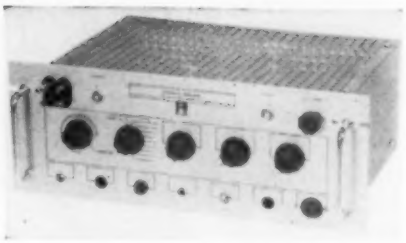
THE CLEVELAND CAP SCREW COMPANY
2944 East 79th Street, Cleveland 4, Ohio
Warehouses: Chicago • Philadelphia • New York • Providence
originators of the Kaufman DOUBLE EXTRUSION Process
Ask your jobber for Cleveland Fasteners

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-105

Universal Amplifier

Now available for delivery is a universal amplifier (carrier type), designed for use in standard 19-inch rack and having a 7-inch front panel. Designated as Model BL-360 by the maker, The Brush Development Co., Instrument Div., 51D, 3405 Perkins Ave., Cleveland 14, Ohio, the instrument was designed for use with the Brush magnetic direct writing oscillographs in studies of static or dynamic strains up to 100 cps when measured by the use of resistance sensitive strain gages. Pressures, temperatures, torque, accelerations and forces may be recorded with these instruments when sensed with the appropriate pick-up device.

The Model BL-360 was designed for use with the SR-4 120 ohm strain gage



but may be used with any gage type with ohmic resistance of 50 to 1000 ohms. Provision is made for operating one to four active gages. The measurable range of the instrument is 10 to 40,000 microinches per inch with one active gage. The sensitivity is increased four times by the use of four active gages.

The control panel contains a ten-step attenuator, terminals for connection of strain gages, calibration resistor holder, resistance and capacity bridge balance controls, gain controls and pen centering control. The amplifier contains a 2000 cycle bridge energizing oscillator, high gain a-c amplifier, phase-sensitive discriminator and d-c output amplifier. Provision is made to permit the use of the d-c output amplifier section as a separate unit. An input jack is supplied for this purpose. **T-8-1061**

Surface Grinder

A surface grinding machine offering a unique and advanced grinding method has been announced by the PDQ Grinder Co., 6 Manhasset Avenue, Port Washington. This grinder is designed for the fast and accurate generation of flat surfaces on various kinds of metal parts including cast iron, steel, tool and stainless steels, die castings of aluminum or zinc, bronze and alloys of various kinds. It is also adaptable to the grinding of plastics, ceramic parts, glass and other materials requiring rapid stock removal and flat surfaces.

The grinding principle employed in the grinder consists of a cylinder-type grinding wheel mounted in a vertical plane and recessed within the actual work surface of the grinding table. The machine employs a large 12 in. diameter cylinder type grinding wheel and permits the finishing of surfaces as wide as 9½ in. and parts can be of any dimensions with this type of machine. This grinder offers extreme ease of operation and eliminates the need for various holding fixtures or magnetic chucks due to the simplicity of the operating principle employed. Work pieces are simply passed across the face of the grinding wheel and the amount of stock removal is regulated by means of a positive feed control governing the depth of cut for various classes of work.

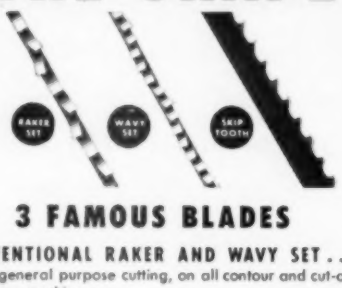
Another feature of the grinder is the removable front section of the work table permitting the grinding of parts having side obstructions or angular surfaces which could not ordinarily be ground on a flat bed type surface grinder. **T-8-1062**

BARNES BAND SAW BLADES

THE SHAPE OF THINGS TO CUT

with BARNES HARD EDGE FLEXIBLE BACK BAND SAW—

Dependable All Ways



3 FAMOUS BLADES

CONVENTIONAL RAKER AND WAVY SET . . . for all general purpose cutting, on all contour and cut-off band saw machines.

SKIP TOOTH . . . Designed for high speed cutting of soft, non-ferrous metals, plastics, wood, rubber, laminated and fibrous materials.

3 PACKAGES . . . for Your Convenience and Economy

1 Handy ARC LINE package—100 FT. COILS Coiled loosely to unwind easily Arc Line is compact for storing—convenient for handling.

2 Economical LONG LENGTH COILS over 100 Ft. You minimize waste using Barnes long, random lengths. Boxed for convenient stripping and safe handling.

3 Uniformly tough WELDED BANDS—to your specifications. Barnes welds are stronger—properly heat treated for strength, toughness and flexibility—thoroughly tested. They combine safety, economy and convenience.

Write Today! Barnes' NEW HANDBOOK of METAL SAWING

FAMOUS FOR QUALITY

W.O. Barnes CO., INC.

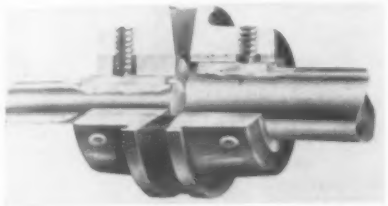
Established 1919

1297 TERMINAL AVE. • DETROIT 14, MICH.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-106

Flexible Couplings

A line of small, compact, durable cast iron bushed type flexible couplings for applications up to 10 horsepower that offers as many as 210 possible bore combinations for each coupling is announced by Maurey Mfg. Corp., Chicago 16. In each of the couplings two cast

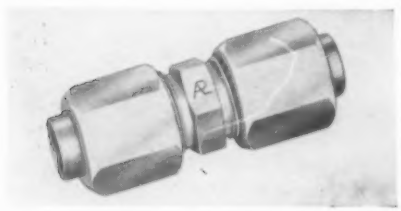


iron hubs are joined by a bonded rubber section perfected by Goodyear Tire and Rubber Co. for this coupling. The couplings are to be available in three bore sizes for use with the three standard Maurey types of interchangeable bushings. The smallest flexible coupling has a 1-in. bore and offers 21 possible bore combinations. With the larger 1-11/16-in. bore and 2-9/16 in. bore flexible couplings, there are 136 and 210 possible bore combinations respectively for each unit. **T-8-1071**

Tube Fittings

In response to the growing use of aluminum tubing for industrial fluid-handling systems, the Parker Appliance Co., Cleveland, announces production of a standard-stock line of aluminum tube fittings for strictly industrial applications rather than aircraft use.

The line includes male and female connectors, elbows, tees, union and tube end reducer for $\frac{1}{4}$-, 5/16-, $\frac{3}{8}$- and $\frac{1}{2}$-in. outside tubing.



This line of aluminum fittings is provided in the same Triple-lok design, the three-piece flare fitting famous for its sleeve, which, in brass, steel and stainless steel, is accepted as the tube fitting standard in a wide variety of industrial equipment and processing installations.

Aluminum is highly resistant to corrosion and reaction with the fluids handled; tube in such alloys as B50S is readily available in long lengths, and has good workability characteristics for easy flaring and bending. System weight is held to a minimum, and total cost is substantially less than for a copper-brass system. **T-8-1072**

FIGURING TOOL COSTS ON PERFORMANCE . . . NOT PRICE, PAYS BIG DIVIDENDS

Productivity—not pennies—is the only way to judge the cost of a tool. No tool deserves a place in your shop unless it can prove . . . on the job . . . that it will enable the machine to operate at peak performance, with minimum downtime.

Kennametal cemented carbide tools are made by processes that are exclusive and expensive, but which are worth far more than the cost . . . because they assure a tool material of consistent soundness.

This Kennametal characteristic pays off—in your shop. In many instances, Kennametal tools will pay for themselves in savings effected in grinding, alone. And this does not take into account reduced tooling costs, and improved production rates attained.

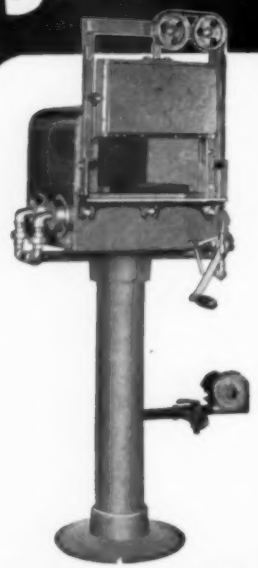
We'll send you, on request, reports that show cost reductions of thousands of dollars on many different operations through the use of Kennametal tooling. But—there is a much better way to demonstrate. That's in your shop, on your job. Ask us to do it.

KENNAMETAL *Inc.*, Latrobe, Pa.

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTIVITY

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-107

SAVE HOURS CUT COSTS



TURN THE HEAT ON TOOLS AND DIES
With Quick-Acting JOHNSON Furnaces

Save time, save gas... heat treat carbon and high speed steel tools and dies with JOHNSON No. 130A. Two sizes offer wide temperature range. Powerful burners provide fast, uniform heat with time saving speed. Temperatures are easily controlled with accuracy. The counter-balanced door opens upwards. Firebox 7" x 13" x 16½". Complete with Carbofrax Hearth, G. E. Motor and Johnson Blower. Write for Complete Catalog. Johnson Gas Appliance Company, 601 E Avenue N.W., Cedar Rapids, Iowa.

JOHNSON No. 130A Hi-Speed
For temperatures 1400° to 2350° F. $295.00
For temperatures 1800° to 2400° F. $325.00
F.O.B. Factory
Models also available in smaller firebox sizes.

JOHNSON
Since 1901
FURNACES FOR INDUSTRY

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-108-1

New **di-acro POWERSHEAR**

OFFERS
CONTINUOUS ACTION
plus
VARIABLE SPEED
from 30 to 200 strokes per minute

for high speed DIE-LESS DUPLICATING

The new Di-Acro POWERSHEAR has remarkable speed and accuracy for the production of small parts.

1. **CONTINUOUS SHEARING ACTION**— no clutch to engage! Feeding speed determines shearing speed.
2. **VARIABLE SPEED** — cycle quickly set for each shearing operation.
3. **EASE OF OPERATION** — fatigue is reduced, production soars.
4. **"SINGLE STROKE" SHEARING** — non-repeating safety clutch for jobs not adaptable to continuous shearing.

Any plant doing high speed precision shearing on smaller parts cannot afford to be without the DI-ACRO POWERSHEAR. Available in 12" and 24" shearing widths, capacity 16 gauge sheet steel. Also standard model.

DOES PRECISION WORK ON ALL SHEARABLE MATERIALS

MICA	LEATHER	ALUMINUM	STAINLESS STEEL
PLASTICS	SILVER	SILICON STEEL	and Many
BIMETALS	MAGNESIUM	CHROME MOLY	Other Materials
FIBRE	COPPER	LEADED BRASS	

SEND FOR 40 PAGE "DIE-LESS DUPLICATING" CATALOG
giving full details on Di-Acro Powershears, also Di-Acro Benders, Brakes, Rod Parters, Notchers, Rollers and Punches.

di-acro

O'NEIL-IRWIN
373 8TH AVE.
LAKE CITY, MINN.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-108-2

Intervalometer

The latest counter-chronograph announced by the Potter Instrument Co., Inc., 115 Cutter Mill Road, Great Neck, N. Y., measures elapsed time in steps of 0.000000125 second. Included are features of dependable circuitry, operating simplicity and convenience in reading.

Known as the Model 470, this intervalometer incorporates on eight-mc crystal oven for a precise time cycle generator. Unique gating techniques limit the error in measurement to plus or minus one-eighth microsecond.
T-8-1081

Six-Jaw Chuck

Availability of a six-jaw chuck for the D-S radial relief grinding fixture is announced by the D-S Grinder Division of Royal Oak Tool and Machine Co., 619 East Fourth Ave., Royal Oak, Mich.

Purpose of the chuck is to permit grinding tools not readily held in a collet or for which no collet in correct size is available and no further early need is anticipated.

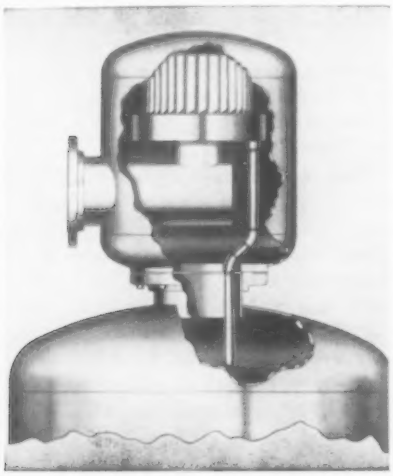
The chuck is a 4-in. Buck model specially adapted for the D-S fixture. Perfect alignment is assured. A shank, precision ground for the D-S spindle, with integral adjustable back plate has been added to the chuck body. The adjustable feature assures concentricity within 0.0005 in. total indicator runout.

The chuck with six hardened reversible jaws centers work easier and quicker without danger of cocking and grips the work more firmly with less pressure than the three-jaw chuck formerly offered. **T-8-1082**

Downflow Purifier

Dirt, moisture, riser discharge and solids are removed before passing on to the distribution piping when this internal downflow purifier is installed in an auxiliary tank immediately above evaporators, packed towers, deodorizers, stills, bubble-cap towers and inside steam drums, flash tanks, receivers and other vessels. Called internal downflow Hi-eF purifiers, they serve numerous functions, depending upon the application. They increase heating efficiency and protect pipeline equipment in steam application. In chemical and petroleum vessels they recover valuable vapors. They increase production in evaporator operation, and in food processing produce a better product.

Hi-eF purifiers carry a guarantee to the boiler industry to deliver vapor with 1.0 P.M. or less of total solids. In other applications the purifier is guaranteed to remove 99 percent of all entrainment. A unique feature of these units is the separating element so designed that the units maintain a constant separating efficiency even as velocities become greater.



Removal of foreign matter is accomplished by means of a multi-stage centrifugal element which engages the entrainment laden vapor at the inlet at the top of the purifier as far away from the liquid level in the drum as possible. In three stages by means of carefully controlled centrifugal force practically all dirt, moisture and riser discharges are removed. The cleaned stream is then passed on through the outlet of the vessel, while foreign matter is discharged to a drain. The design is such that there is no critical pressure drop through the unit. For further information, write The V. D. Anderson Co., 1935 W. 36th St., Cleveland 2. **T-8-1091**

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS of TODAY INFORMATION

Only **THE DUMORE**®

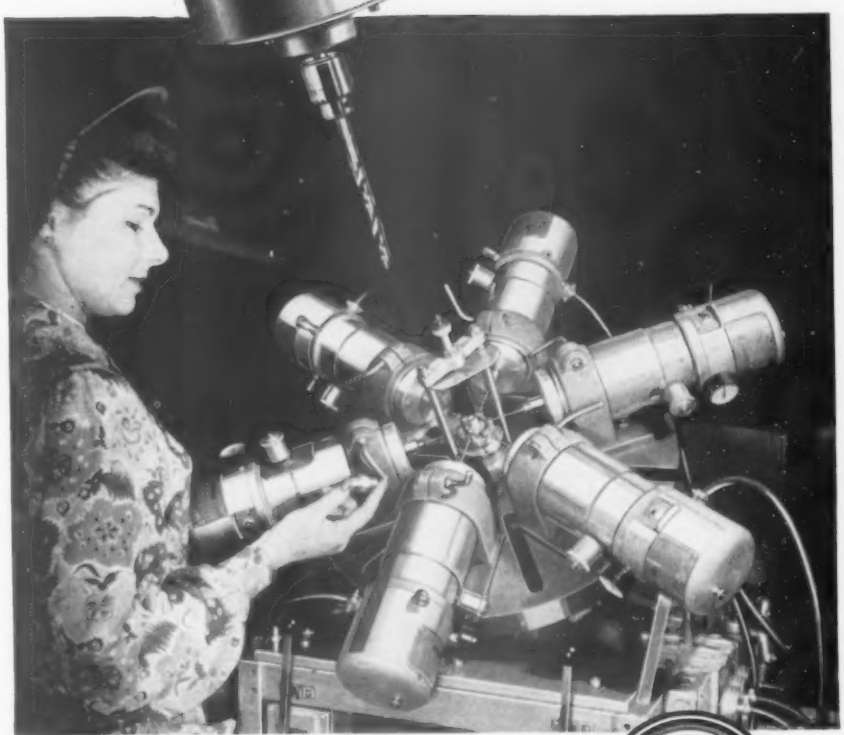
Automatic Drill Head offers the technique of "Resistance Drilling"... eliminates drill breakage

UTILIZING an entirely new drilling technique . . . "resistance drilling" . . . the Dumore Automatic Drill Head is proving it can virtually eliminate drill breakage when used for small-diameter, deep-hole drilling operations.

With "resistance drilling," the workpiece determines the rate of drill feed and speed. The tool always maintains uniform pressure. No need to rely on operator guesswork. Permits working closer to the maximum strength of the drill.

Based on proven field results under average conditions, this tool has set remarkable production records when operating with these drill diameters: up to 3/32" in steel; up to 1/8" in brass, aluminum, zinc and cast iron; up to 9/32" in plastics and wood.

Get all of the advantages of this amazing shop tool. Specify the Dumore Automatic Drill Head. Ask your nearby industrial distributor for a demonstration, or write to The Dumore Company.



This unusual setup is typical of the many ways that the Dumore Automatic Drill Head can save costs on a production problem. Here, labor costs on bronze nozzle holders were slashed $75 on the first run of 5273 pieces.

THE DUMORE COMPANY

1325 Seventeenth Street • Racine, Wisconsin

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-109

Jig Borer

Pratt & Whitney, Division Niles-Bement-Pond Company, West Hartford 1, Conn., has announced a small-size jig borer, which is the second model of a series of completely new design jig borers being added to their present line. It is the smallest of the new machines which feature the Electrolimit measuring system, and has been designated the No. 1E.

The No. 1E provides an accurate machine for precision locating, drilling and high-speed boring in small work. Design improvement in the machine include a heavier and wider bed construction, table and carriage way telescoping guards, built-in Electrolimit measuring system, a new design quill mounting and a control center for faster and easier operation.

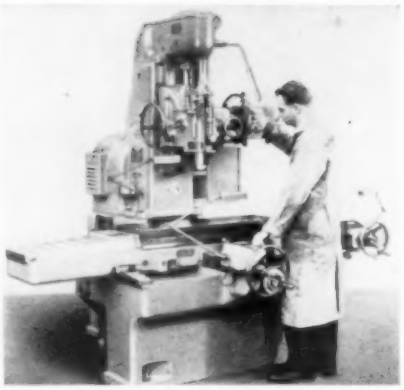


Table settings accurate to 0.0002 in. are made quickly with the Electrolimit measuring system. Two measuring units, entirely independent of traversing screws, control the longitudinal and transverse settings. Basic one-in. spacings are obtained electromagnetically from a solid master bar and registered visibly by a zero reading on an indicating meter. Since there is no mechanical contact involved to cause wear, the original accuracy is retained indefinitely. Fractional inches are obtained by moving a small electromagnetic unit between the inch spacings on the master bar with a super-precision micrometer screw. A large 4½-in. micrometer barrel allows easy reading to 0.0001 in.

The spindle quill mounting is designed to maintain its initial rigidity and accuracy for the life of the machine. The hardened, ground and lapped quill roll feeds on 300 specially selected precision balls. The balls are preloaded between the hardened quill and hardened spindle head bore and are guided in a staggered distribution by a phenolic bearing cage. Hand feed operation is highly sensitive for small-hole drilling.

Spindle speeds and feeds have been increased. The No. 1E has 16 spindle speeds ranging from 65 to 2800 rpm and four spindle feeds, both up and down, ranging from 0.0006 to 0.006 in. per revolution.

Two table sizes are available with increased longitudinal travel on the large size. The 12 x 24-in. table has an 18-in. longitudinal travel and 12-in. transverse travel and the 12 x 42-in. table has a 36-in. longitudinal travel. Special columns 4 or 6 in. higher than standard can also be furnished to increase the normal 20 in. capacity between table and spindle. **T-8-1101**

Mortising Attachment

A mortising attachment has been put into production recently by South Bend Lathe. It consists of a fence assembly which bolts to the drill press work table, a mortising chisel holder which clamps to the drill press quill and three sizes of mortising chisels and bits: ¼, ⅜ and ½ in.

Two new features distinguish this drill press accessory. First, the two guide arms, which are attached to the fence, adjust separately to handle irregularly shaped pieces. Second, the fence has a one-in. independent adjustment on the base. These flexible adjustments give the attachment more capacity, up to 5-11/16 in. under the forked hold-down and as much as 4-7/16 in. between the guide arms and fence.

The South Bend mortising attachment fits all South Bend drill presses and can be adapted to most other makes having a 1¾-in. quill and using a ½-in. chuck. Made by South Bend Lathe, South Bend 22, Indiana. **T-8-1102**

INDUSTRY'S LEADERS — SAY

Sentry

IN HEAT TREATING HIGH SPEED STEEL

Sentry Model 5Y at Draper Corporation, Hopedale, Mass.

Draper Corporation *Cites Sentry Efficiency*

The Draper Corporation, world's largest loom manufacturers, are high in praise of the efficient, economical operation of Sentry Furnaces.

Simple operation and a minimum of maintenance cost are other important reasons why they heat treat their high speed steel the quick, economical Sentry Diamond Block Way!

REQUEST CATALOG D-5

SENTRY MODEL YP
Vertical model for long, slender drills, reamers, broaches, etc.

SENTRY MODEL 2Y
For small tools, cutters of moly, tungsten and cobalt high speed steels.

THE SENTRY COMPANY
FOXBORO, MASSACHUSETTS

INDUSTRIAL ELECTRIC FURNACES AND EQUIPMENT FOR HEAT TREATMENT OF METALS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-110

New XL BOND

FOR CARBIDE TOOL AND CUTTER

Grinding

EFFICIENT ECONOMICAL
ROUGH GRINDING AND FINISH GRINDING
NEAREST THING WE KNOW TO A DIAMOND WHEEL
FOR PRECISION AND OFFHAND GRINDING

Another Chicago Wheel FIRST

"XL" is Chicago Wheel's exclusive new bond for silicon carbide vitrified grinding wheels, especially made for grinding carbide cutting tools. Supplied in most popular sizes and steel backs. Prompt delivery. Keep your production up . . . costs down, with "XL."

AVAILABLE NOW FOR PROMPT DELIVERY

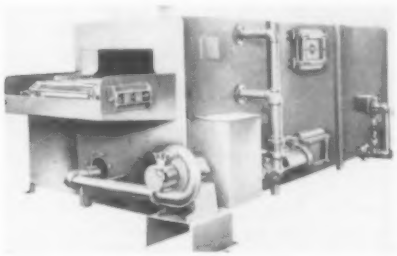
Offices in principal industrial centers
Write for Free Information

CHICAGO WHEEL & Mfg. Co.

Dept. TE, 1101 W. Monroe St., Chicago 7
INDICATE A-8-111-1

Washing Machine

A washing machine designed and engineered especially for removing sand mechanically from steel foundry flasks has been announced by The Alvey-Ferguson Co., Cincinnati 9. In contrast with the method of hand-scraping the flasks, this washing machine removes the sand quickly and completely, which is most important for close fitting when reassembling the parts of the flasks.



This machine utilizes the A-F super-spray cleaning system. The flasks pass along on an A-F bar-type conveyor through consecutive high-pressure, fan-shaped curtains of cleaning solution from above, below and both sides until every inch of the flask is free of sand.

A special feature of this washing machine is a Slo-Flo tank. The cleaning solution, in recirculating through the machine, flows very slowly through this tank, as its name implies. In this way the sand settles out of the solution before it reaches the screen tank which screens out foreign particles that might clog the spray nozzles. **T-8-1111**

Coolant Pump Magnet

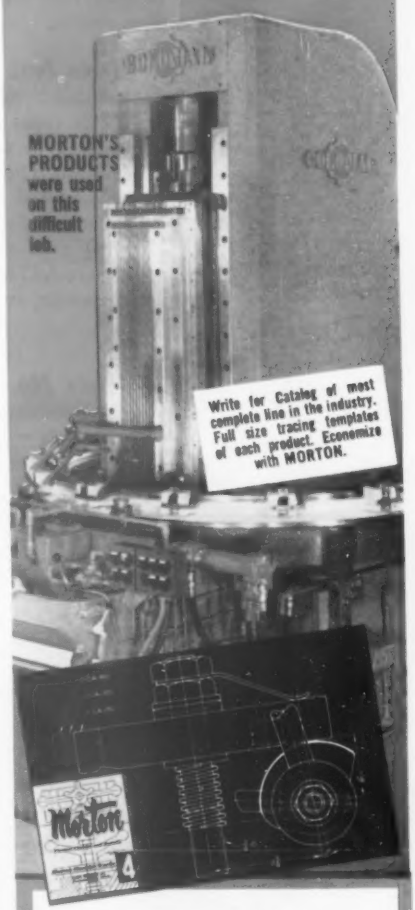
After extensive testing with as many as 50 units in one plant, the Magnetool low-cost coolant cleaner, is now ready for general distribution. It is recommended for toolroom grinders and lathes, or for light production drilling, tapping, valve grinding machines, etc. It is not for heavy production grinding. The powerful magnetic unit, $1\frac{1}{8}$ in. in diameter by 8 in. long is easily suspended under pump intake in coolant tank. All floating steel particles are trapped by the magnet instead of being pumped back into the system to damage work and tools. The unit accumulates a mass of chips $4\frac{1}{2}$ in. long and 1 in. thick around its entire circumference. Load is removed simply by pushing wiper ring to opposite end of tube. Magnetool Div., Multifinish Mfg. Co., Dept. 529, 2114 Monroe Ave., Detroit 7.

T-8-1112

USE READER SERVICE CARD ON PAGE 101 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Specify Morton

Save TOOL and DESIGN COSTS!


MORTON'S PRODUCTS were used on this difficult job.
Write for Catalog of most complete line in the industry. Full size tracing templates of each product. Economize with MORTON.

FIXTURE CLAMPS and COMPONENTS

When confronted with a problem considered impossible by the experts, Mr. Andrew C. Dickson, General Superintendent of Mfg., Detroit Tank Arsenal, and Staff, together with the "Know-How" of Colonial Broach Engineering Staff solved it, resulting in a $400 a day saving. Fully described in March 3 issue of American Machinist.

MORTON MACHINE WORKS

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DETROIT 20, MICH.

INDICATE A-8-111-2

FOR *Strictly* IMPERSONAL INSPECTION CHOOSE AMES DIAL COMPARATORS

Ames Dial Comparators make the inspection of duplicate parts an extremely simple, rapid and accurate operation. Ames Comparators are strictly impersonal in their accuracy — the results being in no way dependent on the skill or judgment of the operator. The pressure of the gauging members against the work is mechanically determined and therefore uniform.

Check the Ames Dial Comparators shown — one of them may solve a Quality Control problem for you.

Ames No. 1 Dial Comparator is an easily adjustable bench model that measures objects up to 2" in cross section. The table bracket may be quickly located and locked in position on the column. The table itself may be further positioned and locked for final fine adjustment. This comparator is designated *Ames No. 1W* when equipped with dead-weight contact pressure and contact area to ASTM specifications for measuring resilient materials, such as rubber, plastics, etc.

Ames No. 2 Dial Comparator is a compact, stable bench model for measuring non-yielding materials — sheet metal, glass, hard rubber. The 2" diameter table is adjustable to bring pointer to zero. *Ames No. 2W* is similar to the Ames No. 2, but is furnished with dead-weight contact pressure and contact areas to ASTM specifications for checking textiles, plastics, sheet rubber, etc.

Ames No. 13 Dial Comparator features flat-ground, cast-iron base of ample size for using V-blocks and locating fixtures for checking rounds, flats and odd shapes. Also, the No. 13 can be fitted with a fine adjustment for close setting. Accurately adjustable bracket holds any Ames Micrometer Dial Indicator.

Ames No. 130 Dial Comparator is designed especially for inspecting comparatively large parts. For this reason, the flat-ground steel base, the adjustable indicator support on which can be mounted any Ames Micrometer Dial Indicator, and the upright column are proportioned to suit the user's particular requirements.

Send us your Quality Control job specifications, and we will supply complete details and proposal without obligation.

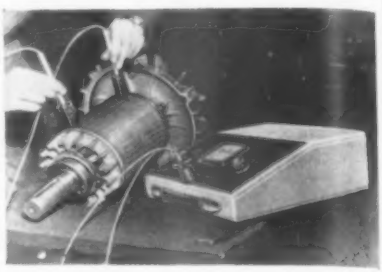
Representatives in principal cities. B. C. AMES CO. *30 Ames Street Waltham 54, Mass.*

Mfgr. of Micrometer Dial Gauges • Micrometer Dial Indicators

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-112

Winding Tester

A portable electronic winding tester so sensitive that it can detect a single shorted turn of #40 AWG wire was announced today by Columbia Technical Corp., 5 East 57th St., New York 22. This production, maintenance and field-use, and laboratory instrument is designed to detect faults in and to prevent breakdowns of electrical motors and generators of all sizes and types, coils, and similar electrical equipment. It is a practical tool for preventative maintenance, production control and motor repairs.



Known as the PMD tester, it enables the user in a matter of a few seconds to detect the location as well as the nature of an electrical fault in any type of winding. The presence and location of open circuits, shorts to ground, shorts between phases or between turns, reversed terminal connections, wire breakage, and material defects can be found in a minimum of time even with unskilled labor.

The motor tester consists of a power supply unit, a vacuum tube oscillator, a regulator and rectifier circuit, equipped with standard tubes, and a full-view, clearly calibrated meter, all housed in a sturdy portable case. The total weight of the unit is only 13 lb.

T-8-1121

Immersion Heater

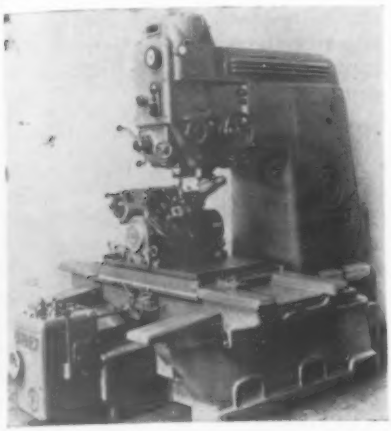
First of its type to be tested and approved by leading electro-chemical suppliers, the Glorod electric immersion heater overcomes the many problems inherent to the heating of corrosive solutions.

The Glorod introduces a unique type of fused quartz heater, totally inert to acids, which requires no cleaning nor maintenance. As one of the best electrical insulating materials known, fused quartz also eliminates stray currents in electroplating work.

A few of the features are functional design, versatility, and lightweight for easy handling in all metal finishing work. Rugged construction provides complete protection against physical abuse. Complete range of standard sizes is available from stock. Made by the Cleveland Process Co., 7016 Euclid Ave., Cleveland. **T-8-1122**

Jig Borer

Table settings accurate to ±0.00032 with maximum error between two bore holes held within ±0.0004 are provided by a direct-reading micro-optical measuring system built into the German-made Lindner jig borer, now being distributed in the U.S.A. by Kurt Orban Co., Inc., New York.



A fine helical line, diamond-inscribed on mirror-finished cylinders, provides the basis for optical reading of the fine adjustments of both longitudinal and transverse movements. Rotatable cylinders, connected to the coordinate slides, enable intermediate measurements from thread to thread to be set on an annular scale to ±0.00004 and read through the microscope. The accuracy of adjustment is maintained throughout the life of the machine.

Infinitely variable spindle speeds from 50 to 1900 rpm in Model 15 and 70 to 2000 rpm in the smaller Model 14, are provided.

Model 15 has a table movement of 40 (longitudinal) by 24 in. (transverse). Distance between table surface and boring spindle is 10-in. minimum and 30-in. maximum; in special designs, maximum distance can be increased to 34 or 38 in. **T-8-1131**

Cutting Carbide

A new grade of cutting carbide has been developed by Newcomer Products, Inc., of Latrobe, Pa. This carbide is known as grade S-6.

S-6 has been tested and used in industry for approximately a year and a half, and has proven to be highly efficient where the nature of the job makes slow speeds necessary. Even though S-6 can be used at high machining speeds, its greatest tool life is obtained at speeds slower than those at which other grades of carbide can be successfully used. S-6 is therefore suitable for use on old or slow-speed machines.

S-6 is excellent for interrupted cuts. It removes stock fast because of the heavy feeds is permissible. **T-8-1132**

VLIER

TOGGLE PADS

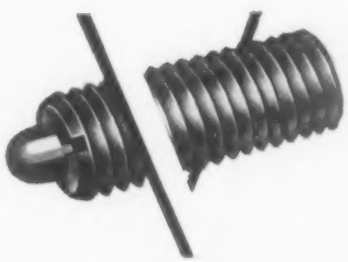
Simplify Clamping On Uneven Surfaces

Wherever clamping is done, the Vlier Toggle Pads are practical necessities. These tools will operate with almost any type of clamp or jack, and insure accurate holding because of self-aligning and leveling feature.

Each pad has a 20° (included) angle movement for permitting adaption to uneven or off-angle surfaces. A special "jamming" feature prevents loosening during work, yet allows easy removal from clamp or jack.

All Toggle Pads are made of the finest cold-finished steel, accurately machined for trouble-free performance. Smoothly radiused—gives instant alignment with no "dead" spots. Polished base provides secure seating on any surface at any angle.

Vlier Toggle Pads are available in five sizes. Precision manufacture provides trouble-free service. Like all Vlier products, these units are economically priced, fully guaranteed. There is a local Vlier distributor to serve you.



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Torque Thumb Screws, Spring Plungers, Spring Stops, Fixture Keys.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-113

TRADE LITERATURE

Free Booklets and Catalogs Currently Offered By Manufacturers

Contour Forming

Instructive brochure presents clear picture of an answer to modern contour forming problems and its advantages over conventional metal forming methods; describes how parts are formed tangentially by stretch or compression forming on only one die, and how extrusions are contoured to shape. Illustrated. **The Cyril Bath Co.,** 6880 Machinery Ave., Cleveland 3. **L-8-1**

Gear Shapers

Bulletin No. 1800-52 covers improved line of Series 1800 shear-speed radial gear shapers, describing and illustrating latest applications for air clamping of work, shaping of teeth on small pump gears, large bull gears and bull gear clusters, points out various design and structural changes. Includes specifications. **Michigan Tool Co.,** 7171 McNichols Rd., Detroit 12. **L-8-2**

YOU SAVE TIME
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YOU GET QUALITY
YOU GET QUICK SERVICE
LODDING Clamp Assemblies and Standard Fixture Components are produced in quality and quantity. Forgings are used wherever practical. All parts are Parkerized for rust prevention.
LARGE FACTORY AND DISTRIBUTOR STOCKS ASSURE QUICK DELIVERIES.
CATALOG AND TRACING TEMPLATES AVAILABLE UPON REQUEST.
LODDING, Inc.
WORCESTER, MASS.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-114

Measuring

Sixty-three-page booklet, illustrated in color, tells the story of measuring devices from the time of Noah to today and through to the precision measurements and devices of tomorrow. Available to teachers, schools, libraries and educational institutions. **General Motors Corp.,** Educational Relations Activity, Detroit 2. **L-8-3**

Dies

Designed for quick reference, 32-page standard die catalog, complete with detailed diagrams, charts, tables and illustrations of typical machinery and equipment, facilitates ordering of standard punches and dies of various types for hand, foot, power presses. Sales Dept., **Federal Machinery Co.,** 134 Grand St., New York 13. **L-8-4**

Cutting Tools

Brochure offers several lines of Gairing's standard cutting tools; illustrative drawings, descriptions and dimensional tables give details of each type. **The Gairing Tool Co.,** 21221 Hoover Rd., Detroit 32. **L-8-5**

V-Drives

Widely illustrated V-drive catalog designed as useful and convenient source of buying information on fractional to 10-hp V-drives, drive parts and accessories. Engineering data section provides general information on proper selection for particular requirements. Catalog Dept., **Maurey Mfg. Corp.,** 2915 S. Wabash Ave., Chicago 16. **L-8-6**

Shapers

"How to Run a Metal Working Shaper," although designed as a manual for the 7-in. shaper, is actually a handbook for either the apprentice or experienced machinist. Photos, diagrams and exploded views show internal parts. Explains how to grind differently formed tool bits for shaper cuts and how to handle the many job set-ups used in shaper work, all outlined in simple, easy-to-follow steps. **25¢ South Bend Lathe Works,** South Bend 22, Ind. **L-8-7**

Heat Treating

Applications of the latest developments in heat treat equipment and processes are reviewed in well illustrated Vol. 3, No. 1, Heat Treat Review. Includes articles on "How to Cut Heat Treat Costs," "What Builds a Quality Heat Treat Shop." Editor, *Heat Treat Review,* **Surface Combustion Corp.,** Toledo, Ohio. **T-8-8**

Eyelet Setting

Twelve-page booklet presents comprehensive information on eyelet setting, explaining in non-technical terms how eyelets are made, how they should be selected and how they can be employed to best advantage; also discusses machines for the work, and includes drawings for clarification. **Edward Segal**, 72 Spring St., New York 12.
L-8-9

Diamond Tools

Informative 27-page brochure "Diamond Tool Engineering" presents facts on the subject aimed at speeding up top quality work; data covers suggestions in selection of size, shape and quality of diamond tools to do a given job, feeds and speeds, high-speed techniques, wheel and thread work, correct adjustments, coolants, etc. **Maurice S. Dessau Co., Inc.**, Bank of Manhattan Bldg., 535 Fifth Ave., New York 17.
L-8-10

Precision Measurement

"Dimensional Control and Gaging Policy" covers gaging policy, tolerances, reference temperature, gage specifications, ordnance practices, fixed gages, instruments, multiple semi-automatic and automatic gaging devices; also contains illustrations, charts and descriptions of various kinds and types of gages and precision measuring instruments. **The Sheffield Corp.**, Dayton 1, Ohio. **T-8-11**

Metallizing, Vacuum

Comprehensive catalog No. 725, "Vacuum Metallizing Today," describes the process and explains how it can be applied to surfaces of plastics, metals, glass, paper, textiles, leathers and other products; outlines and illustrates schematically the basic principles involved including pre-treatment, drawing of vacuum, metallizing and finishing. **F. J. Stokes Machine Co.**, 5500 Tabor Rd., Philadelphia 20. **L-8-12**

Cylinder Power

"Cylinder Power in Action" illustrates 16 cylinder-powered movements and shows 21 actual application photographs; also describes how cylinder power can be utilized to speed production on various types of machines and equipment. **Hanna Engineering Works**, 1765 Elston Ave., Chicago.
T-8-13

Straightening

Function, operation and capacities of the "308" series of variable speed straightening machines is discussed in illustrated bulletin which outlines how this machine simplifies advantageous use of coil stock. **F. J. Littell Machine Co.**, 4127 N. Ravenswood Ave., Chicago 13. **L-8-14**

Grinding

A belt grinding attachment which gives an abrasive belt the maneuverability of a portable grinder is discussed in illustrated folders BGA-21 and BGA-42 which illustrate the many specific uses and advantages. **Buckeye Tools Corp.**, Div. 31, P. O. Box 966, Dayton 1, Ohio. **T-8-15**

Aluminum Alloys

Brochure lists in reference form composition, typical mechanical properties and heat treatments of standard aluminum alloys produced by Apex. **Apex Smelting Co.**, 2537 W. Taylor St., Chicago 12. **T-8-16**

Grinding Cylindrical

Revised catalog describes Landis universal precision cylindrical grinders; widely illustrated, it includes complete specifications as well as information on typical grinding set-ups possible with these machines. **Landis Tool Co.**, Waynesboro, Pa. **T-8-17**

Spacing Tables

Illustrated brochure explains in testimonial fashion the use, operation and advantages of Bullard spacing tables and their importance in production at the Norton Co. "The Norton Story of Bullard Spacers." **The Bullard Co.**, Bridgeport 2, Conn. **T-8-18**

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A·B·C DRILL JIG BUSHINGS ...
Produced from electric furnace alloy steel containing chromium and/or tungsten, A·B·C Bushings deliver at least 10% longer service

A·B·C PRECISION QUALITY PIERCING PUNCHES ... of premium steel — in two basic types: *Water Hardening Tool Steel* of guaranteed standards of both grain size and hardenability . . . and *High Speed Steel*. Points ground on special fixtures, designed and built in our own plant, to insure absolute concentricity between point and shank.

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A·B·C products are heat treated, including quenching, under neutral atmosphere electronically controlled. Hardening and tempering temperatures throughout the heat treatment are instrument-recorded.

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North East West South IN INDUSTRY

American Cyanamid Co., has announced the promotion of **L. R. Forrest** to staff assistant to the works manager at the company's Warners Plant in Linden, N. J. Mr. Forrest, who formerly served with Industrial Chemicals Division's New York production department, will coordinate plant engineering and chemical engineering problems.

Paul L. Wright has been appointed manager of the Buffalo plant of **Joseph T. Ryerson & Son, Inc.** He succeeds **Clarence S. Gedney**, manager for the past 23 years, who is retiring. Mr. Wright, who has been sales manager for the past year, has been associated with Ryerson since 1939 except for a three-year interruption while he was in military service during the war.

LIQUAMATTE
WET BLASTING

Reduces Finishing Time 50% to 80%

Finishing a broach in the Liquamatte

for Oling Tool Co.

The Oling Tool Co. of South Bend, Indiana is realizing the increased economy that results from the speeded finishing operations of Liquamatte wet blasting. Long and drawn-out manual methods have been done away with, as the Liquamatte saves an average of 50% on former time and labor requirements for surfacing tools prior to plating. On some items such as drill bits the savings have been as high as 80%.

Oling noted these advantages which are so important to the tool industry:

Closer Tolerances **Using very fine mesh abrasives suspended in water and projected upon the work at high velocity, the Liquamatte finishes parts while holding tolerances as close as .0001". Tools are blasted without the cutting edge being dulled.**

Stronger Bond **Chrome plating is only as good as the surface to which it is bonded. The Liquamatte leaves a matte-type finish on the tools. This increases the available surface area for the plate to cling to and results in a very strong bond.**

Brighter Appearance **Blasting the item after as well as before plating assures a much cleaner and brighter surface.**

Superior Lubricant-Retention Qualities **In addition to the brighter appearance, wet blasting after plating eliminates the break-in operation. The surface is easily and thoroughly wet with a lubricant from the minute the tool is put into service.**

Get the facts on Liquamatte wet blasting. Write today.

Send today for Bulletin No. 23 or ask for a demonstration.

American LIQUAMATTE WET BLASTING
WHEELABRATOR & EQUIPMENT CORP.
856 S. Byrkit St. Mishawaka, Ind.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-116

George Arents, dean of **American Machine and Foundry Co.**'s board of directors and one of the founders of AMF in 1900, has been named chairman of the board of trustees of Syracuse University. Mr. Arents has been vice-chairman of Syracuse's board for a number of years.

Eugene E. Durst has been promoted to the newly-created position of technical assistant to the manufacturing vice-president of **Wico Electric Co.** Mr. Durst, who now assumes responsibilities of long term planning and manufacturing research, has been in charge of manufacturing engineering functions for Wico for the past eight years. Mr. Durst is a member of ASTE Springfield (Mass.) chapter. Succeeding him as manufacturing engineer is **Vincent Bagnall** who has been in charge of Wico's methods department since 1948.

Eugene Durst

Paul Diserens

After 43 years of continuous service, **Paul Diserens**, director of research and development of **Worthington Corp.** and its subsidiary companies, has retired from those responsibilities, but will continue with the corporation in a technical consulting capacity in engineering and research. During his career, Mr. Diserens was a substantial contributor to the establishment of engineering research as a basis for progress and development in power plant engineering. **Ralph M. Watson**, formerly assistant to the vice-president in charge of engineering, succeeds Mr. Diserens. Earlier during his 16 years with Worthington, Mr. Watson has served as an engineer in the refinery pumps section of the Centrifugal Pumps Division and as chief engineer of that division.

Three new vice-presidents have been named at **Illinois Tool Works. Austin E. Cole** was elected vice-president and treasurer; **J. B. O'Connor** became vice-president and manager of new product development, and **Robert F. Dick** became vice-president and assistant to the president. The additions to the organization structure were announced as a part of the company's long term program for new growth and marketing possibilities.

During the closing session of the General Assembly of the International Organization for Standardization, **Dr. Hilding V. Törnebohm** was elected president of the organization. He succeeds **Dr. Albert Caquot**, French engineer, whose three-year term of office ends December 31.

Dr. Törnebohm has been vice-president and technical director of SKF Industries in Gotenborg, Sweden, since 1941. A pioneer in Swedish and international standards work, he was president of the Swedish Standards Association from 1941 to 1949 and now is chairman of its ball bearing and screw threads committees. He holds numerous patents concerning machine design and gaging tools, and has been decorated by the governments of Sweden, Finland, Denmark and Norway.

M. Lawrence Price, professor of machine design at Worcester Polytechnic Institute, has been granted a leave of absence in order to devote his entire time to fundamental research for **Reed Rolled Thread Die Co.** Prof. Price has been carrying on this work on a part time basis for some time.

Recent appointments announced by **The Pivot Punch & Die Corp.** included **Paul J. Allwein** who was named assistant to the works manager, and **James G. Deckert,** who was appointed assistant to the controller. The appointments were a result of expanded company activities, the announcement said.

According to recent announcement, **Eugene S. Page** has been named special assistant to the executive vice-president of **American Machine and Foundry Co.** Prior to joining AMF, Mr. Page directed purchasing activities for the Great Lakes Carbon Corp.

Robert L. Brehm has been made assistant chief engineer of **Snyder Tool & Engineering Co.** and its subsidiary, **Arthur Colton Co.,** according to a recent announcement. Mr. Brehm, who has been associated with Snyder since 1940, was responsible for electrical and hydraulic engineering for special purpose production machinery and in 1949, when Snyder purchased Arthur Colton Co., he assumed similar engineering responsibilities for that company's products.

Myron Ceresa has been named manager of electroplating projects for the Special Products Development Div. of **Westinghouse Electric Corp.** Mr. Ceresa, who joined Westinghouse in 1937, will be in charge of laboratory operations, including development, pilot plant and technical service work.

During a recent election at **Borg-Warner International,** export trade division of Borg-Warner Corp., **L. G. Porter** and **Ray P. Johnson** were named vice-presidents of the company. Mr. Porter also is treasurer and Mr. Johnson administrative assistant to the president of Borg-Warner Corp.

At the same time, **Robert A. Brown,** comptroller, was elected treasurer of Borg-Warner International, while **J. W. DeLind, Jr.,** and **R. W. Dose** were re-elected president and secretary respectively.

At its recent meeting, the board of directors of **Allis-Chalmers Manufacturing Co.** elected **R. S. Stevenson** vice-president of the company. Mr. Stevenson previously was vice-president in charge of the tractor division.

Coming Meetings

Aug. 12-16, National convention of **Photographic Society of America,** presents symposium "Photography in Engineering and Science." Hotel New Yorker, New York City.

Sept. 4-5, eighth national conference on Industrial Hydraulics sponsored by **Illinois Institute of Technology** held in conjunction with Centennial of Engineering. Sherman Hotel, Chicago.

Sept. 8-12, fourth annual Industrial Engineering Conference sponsored by Industrial Engineering Section, Mechanical Engineering Department, Michigan State College. East Lansing, Mich.

Sept. 10-12, 14th annual shop Practice Forum of the **Porcelain Enamel Institute** at University of Illinois, Urbana. Open to both members and nonmembers of PEI.

Sept. 30-Oct. 3, 1952 Iron and Steel Exposition and the annual convention of its sponsoring organization, **Association of Iron and Steel Engineers,** Cleveland Public Auditorium. Cleveland, Ohio.

with "DETROIT" you save mounting costs, increase production runs

First: "Detroit" craftsmen, working with finest precision equipment, take pride in the superior quality of every "Detroit" Die Set. ***Second:*** Every set is fully assembled and inspected at the factory. Here are complete inspection facilities and testing skill that mean each "Detroit" Die Set is right before it is shipped.

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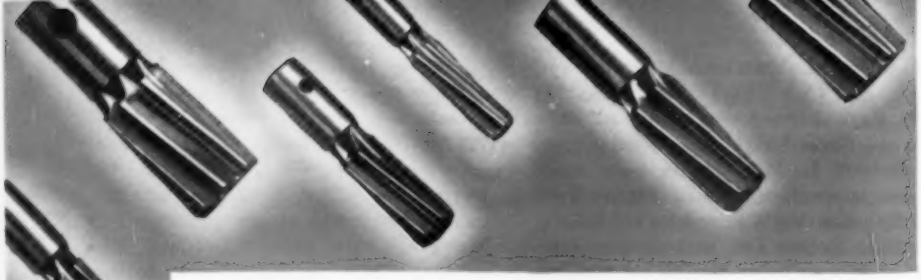

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REDUCE TOOLING COSTS...

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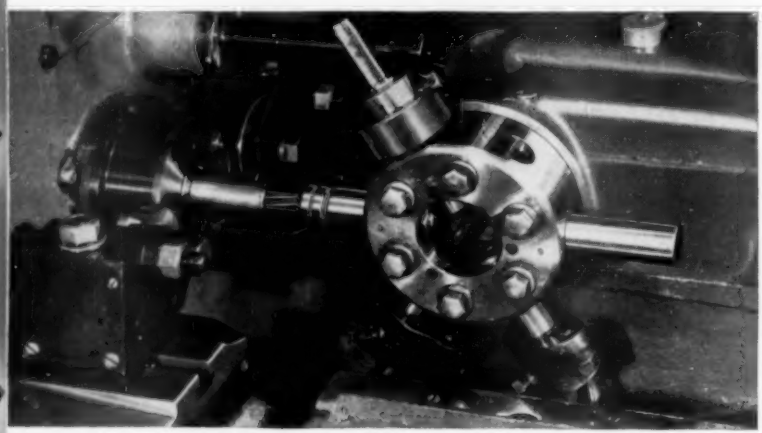

The "P & W" marking is your assurance of outstanding performance. High speed steel, skillful heat treating and correct design with ample chip clearance mean fast, free cutting performance, long life and low cost. Holes are round, straight and accurately sized. P & W FLOATING HOLDERS are recommended as an additional aid to reaming accuracy.

Any decimal size from .060" to 1.010" can be furnished promptly and inexpensively from extensive stocks of semi-finished hardened blanks. The entire range of 24 basic sizes requires only 6 standardized shanks and 5 overall lengths. Required holders, cam changes and set-up times are all greatly reduced. For complete information, write on your Company letterhead to the Branch Office nearest you — or direct to West Hartford; ask for the new Pratt & Whitney Bulletin No. 552.

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CUTTING TOOLS • GAGES • MACHINE TOOLS

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Abstracts of Foreign Technical Literature

By M. Kronenberg

Great Britain: Micro-drilling—the term now commonly applied to the drilling of very small holes—is of particular importance in the manufacturing of diesel atomizer jets, spinnerettes for synthetic yarn, watches, clocks and other such products.

While twist drills are made as small as 0.0135 in. in diameter, micro-drilling starts from this size and goes down to diameters as small as 0.002 inches.

Success in drilling very small holes depends to a large extent on the machine employed, as indicated in an article by R. A. Manley published in the British edition of *Machinery* of June 5. If the machine tool is subject to vibration or has runout, the hole will not be accurate and the drill will break easily. Many users of micro-drills are under a misapprehension regarding the speeds at which these drills should be run. If the speed is calculated on the basis of a recommended surface speed employed in ordinary drilling operations, the spindle speeds will be considerably too high. The author recommends running small drills, when drilling brass, at 2000 to 9000 rpm; when drilling mild steel, at 1500 to 4500 rpm; and when drilling stainless steel, at 1300 to 4000 rpm. The lower figure in each case refers to a micro-drill of 0.002 in. in diameter, the upper one to a diameter of 0.040 in. The article deals also with production data, methods of location and other items of micro-drilling.

Fundamental factors governing the plastic behavior of metal during any cold forming process are discussed in an article by K. Sieber in the British edition of *Machinery* of May 22.

The first practical law for plastic flow indicates that the volume of material worked remains unchanged during the process of changing the shape. The second law states that the force and the work requirements for cold forming depend upon the degree of dimensional change in the three principal directions of space irrespective of whether lengthening or shortening occurs.

The author derives an "index of plastic deformation" which is the natural logarithm of the ratio of the original area of the cross section of the material to the area after cold working. Although this index may seem to be inconvenient to use in practice, it per-

mit easy calculations because all important factors in cold forming such as force, pressure, work requirements and work material properties depend upon this logarithmically defined index. It is shown in the paper that the resistance to form change depends on grain structure and chemical composition and that this resistance can be expressed numerically in terms of the index and that charts can be plotted which are easy to read. Likewise, the mean formability is related to the index.

The oldest conception of wear visualizes it as a mechanical process in which two bodies rubbing together continually interlock the protuberances of their irregular surfaces and force them to shear off. A large percentage of wear cases, however, are of a chemical nature as discussed in a paper presented by J. J. Broeze before the Conference on Abrasion and Wear held at Delft, Holland and reported in *Engineering* of May 30. The author differentiates between three typical fields of wear which are of practical significance where chemical attack is encountered, namely by the atmosphere, in gear lubrication caused by lubricants and in engine lubrication.

Among the advances in engineering during the war few were more remarkable than those in automatic control mechanisms centered around radar equipment.

Some of the problems encountered at that time may come up again in the present development of servo-controlled machine tools. The British Ministry of Supply, York House Office, Kingsway London, WC 2, has recently released information on such mechanism in a booklet entitled "Servo-Mechanisms," published as Vol. 5 of the Government Research Report. The report covers both the difficult mathematical sides of servo controls and practical conclusions, among them the effect of air in the oil on hydraulic transmissions.

In a paper on the machining of small instrument parts presented recently before the Society of Instrument Technology by K. J. Wolfe and P. Spear, a section was devoted, according to an article in *Machinery* of May 8, to the influence of metallurgical factors on machining. The dominant factor influencing machinability, it is stated, is the association of properties known as hardness, in conjunction with the work-hardening effect. Second in importance to hardness is microstructure but its determination requires special techniques and is not readily accessible to the machine shop. The authors present some information which relates machinability to structure as revealed by micro examination, and in this way subdivides materials according to the carbon contents.

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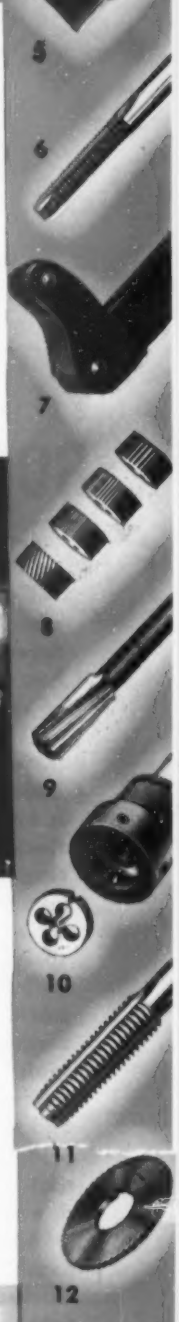

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Germany: The determination of the most economical tool life is the topic of a paper by H. J. Burmester published in November, 1951, in *Werkstatt & Betrieb*. After reviewing the different methods used for determining tool life, the author comes to the conclusion that only a cost analysis can determine the exact point or conditions at which the tool should be reground.

He subdivides tool cost and indicates that the cost depends on tool cost per tool life per grind, the number of components machined and on the relationship between the number of components and tool wear.

His analysis, which is supplemented by numerous charts and diagrams, winds up with a number of recommendations. He finds that tools should be used to maximum wear in cases where tool failure is less significant or likely than surface finish. If, for instance, the surface finish is a critical consideration it is not economical to regrind the tools as long as the surface finish is acceptable. In such cases frequent regrinding is wasteful.

On the other hand, if surface finish is a secondary point of view and considerable tool wear is acceptable as in roughing operations, tool failure costs become predominant and determine optimum condition. This case arises with simple carbide tools when failures reach the 5 percent level.

An article published in *Stahl & Eisen* in April by W. Papsdorf deals with friction, wear and lubrication in wire-drawing operations. After considering some historical developments the author gives an explanation for friction conditions, lubrications and boundary conditions. Data are given for coefficients of friction for various gliding velocities and unit pressures. The author considers also the wear of drawing dies and the effect of viscosity, temperature and pressure on wear.

Interference microscopes for measuring surface roughness usually can not be used when the roughness is less than 40 micro inches (0.000 040 in.), although many turned and ground surfaces fall within this category of surface finish. E. Zehender has therefore developed a new method combining the "Fax-Film Method" with the interference method and was able to obtain data which could not be determined before when placing the workpiece or a section of it under the interference microscope. He applies a fax film to the surface to be measured and puts it under the interference microscope placed between prepared glass plates or submerged in a liquid. Numerous machined surfaces are shown in the author's paper which appeared in *Zeitschrift des Vereins Deutscher Ingenieure* of May 21.

Good Reading

A GUIDE TO SIGNIFICANT BOOKS AND PAMPHLETS OF INTEREST TO TOOL ENGINEERS

HANDBOOK OF ENGINEERING FUNDAMENTALS, *edited by Ovid W. Eshbach. Published by John Wiley and Sons, Inc., 440 Fourth Ave., N.Y. 16. Price, $10.*

The second edition of this handbook should prove even more useful than the original published in 1936. Extensive additions have been made and some of the original material has been revised. The Handbook itself needs no introduction to engineers, since it has long been one of the standard items for the book shelf.

Contributors to this and the original edition are among the best known authorities in the several fields of engineering practice and education. In addition, care has been taken to have the material reviewed by several other people in most cases to assure a correct and precise presentation. Where more detailed or deeper understanding of any subject may be required, numerous references are given to both historical publications and recent literature.

Among the sections which have been revised are those on the treatment of mathematics, systems of units, theoretical and applied mechanics, mechanics of rigid bodies, fluid mechanics, electricity and magnetism, engineering materials, and engineering law. The engineering tables have also been reviewed and enlarged.

BOLT, NUT AND RIVET STANDARDS. *Published by the Industrial Fasteners Institute, 3648 Euclid Ave., Cleveland 15, Ohio. 247 pp.*

This volume is a revision of the so-called "Red Book" published in 1941, and has been prepared under the supervision of the Institute's Committee on Standards and Technical Practices. It is published to aid production in the manufacturer's plant and as a service to users in acquainting them with accepted standards of nomenclature, dimensions, sizes and other practices. These standards have been developed over an extended period of time through consultation among manufacturers, users, and national engineering societies. Many of these standards have been developed and approved through the procedure of organizations such as the American Standards Association and the Division of Simplified Practice of the U. S. Department of Commerce.

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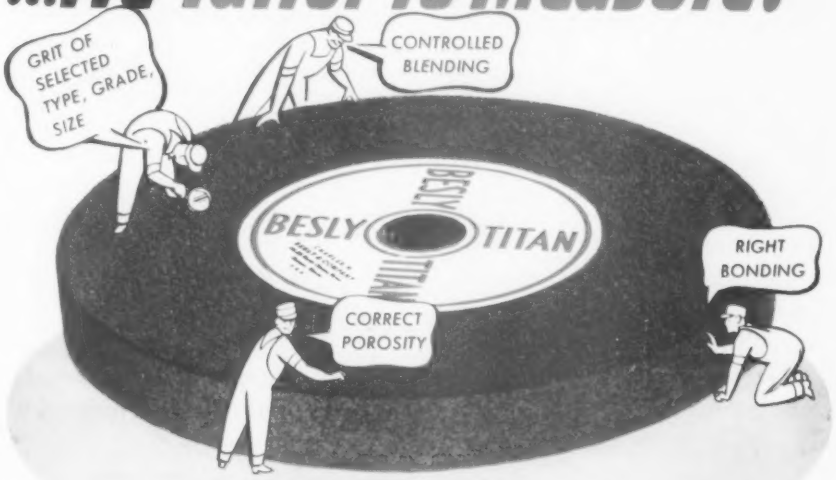

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Technical Shorts . .

THE MANY safety hazards associated with static electricity, as well as the increasing industrial dangers have brought about such a growing demand for information on the subject that the National Bureau of Standards is making a study of the problem. Currently the Bureau is enlarging its research and standardization program for establishing and evaluating methods of measurement of electrostatic forces and for determining the properties of materials and equipment used to reduce the hazard.

Obviously, the most serious hazards are those of ignition of flammable gases or dusts. It has been determined that the risks can best be lessened by reducing the flammability or eliminating exposure to the flammable agent. Of course, these measures also reduce hazard from other sources of ignition, and thus increase safety from several angles. When coupled with exclusion from the area of materials such as plastics, wool, and rubber, which seem to generate high electrostatic charges, these measures often are sufficient to reduce the hazards to a negligible value, the researchers have found.

More elaborate methods of mitigation depend upon reuniting the charges as fast as they are separated in order to keep the voltage across the affected objects low. This can be accomplished by connecting stationary metallic objects to a common ground, by humidification (which provides a film of moisture of moderate conductivity on most objects), or by installing a conductive floor to provide electrical contact with the objects that move or rest upon it. The latter is generally considered the safest method where persons or moving objects may separate charges.

An interesting point not always considered is that location may heighten danger of the electrostatic spark in what might seem an inconsequential area. The secondary effect, for example, could be the dangerous one to a person who received an insignificant shock but who, at the time, was balanced atop a step ladder.

A NUMBER of films have been released recently by firms interested in informing industry, educational organizations and the public in the various phases of their operations and products.

"Gaging for Profit," a 16-mm color sound film released by Federal Products Corp., shows practically all known modern methods of gaging for the control of dimensional accuracy. Scenes taken in customers' plants show typical gages in use while a short outline of Federal's educational work in quality control accompanies a demonstration of the value of indicating gages in statistical quality control. Gages for continuously measuring bare and insulated wire or strip material, as well as gages which automatically control machines so as to maintain finished material to specified sizes, are shown while multiple dimension and automatic sorting gages are pictured doing their sorting work. Details concerning gratis use of the film, which requires about 38 minutes, is available from the company's offices, 1144 Eddy St., Providence 1, R. I.

Jones & Lamson Machine Co. also have a 16-mm color sound film, "What's the Difference?" The 21-minute movie tells the full story of the optical comparator, from comparison to precision measurement, with aid of production line scenes under actual working conditions. Information about the film is available from Jones & Lamson's Dept.

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710M, Springfield, Vt., about both this moving picture and also about a 90-frame silent slide film.

Processing features and materials handling applications of the Stevens full automatic barrel plating machine are the subject of a 20-minute sound film prepared by Frederic B. Stevens, Inc. It presents the effectiveness of the machines in high-speed production operations, and step-by-step views analyze the entire operating cycle to show actual demonstration of just what the equipment can do to speed flow and processing of work. Arrangements for showings of this picture can be made with Stevens representatives or through the company's headquarters, Detroit 16.

An educational color movie, requiring about a half-hour running time, explains "Chucks and Their Uses." Of equal interest to apprentices or to experienced engineers and production men, various scenes show parts, construction, mounting and use of independent, universal scroll and power chucks. A unique scene includes a study of stresses and strains using a 10-in. plastic chuck photographed under polarized light, spindle noses and mounting, tests for runout and balance. Another part shows horsepower requirements of modern machine tools and yet another explains design and application of machine vises. Further information may be had from The Skinner Chuck Co., New Britain, Conn.

A fifth film, requiring 15-minutes to view, features plant maintenance operations, and points out how a number of the country's important industrial plants have increased efficiencies and economy through use of fork-lift trucks and towing tractors in maintenance operations. Requests for the film "Serves You Right!" should be addressed to Clark Equipment Co., Industrial Truck Div., Battle Creek, Mich.

"Induction Heat", a sound movie released by Allis-Chalmers Manufacturing Co., shows the use of induction heating in industry and emphasizes the effectiveness and speed of the method and demonstrates its possible versatility through the use of different work fixtures. A brief visual explanation of how induction heating operates is included in the film.

Production scenes cover heating of steel strip for baby buggy springs, annealing of automobile brake arms, brazing fittings into refrigerator compressor housings and hardening localized areas of a rocker arm shaft.

Running time for the 16mm color film is 20 minutes. Available for group showing upon request from the company's Advertising and Industrial Press Dept., General Machinery Div.

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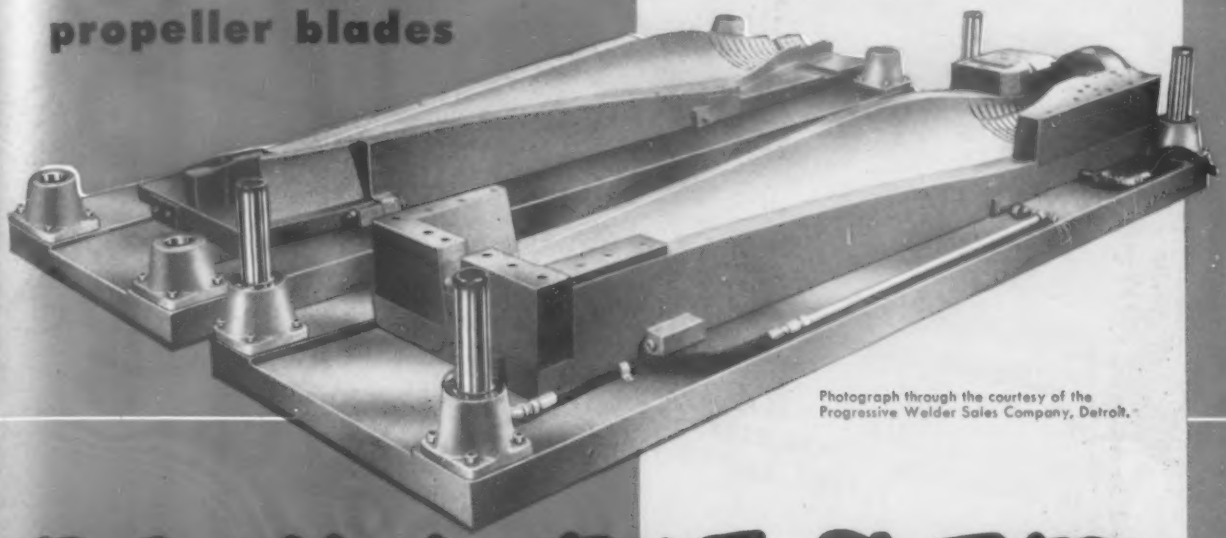

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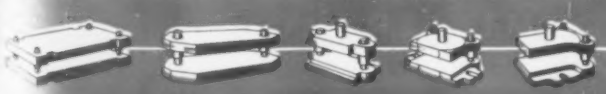

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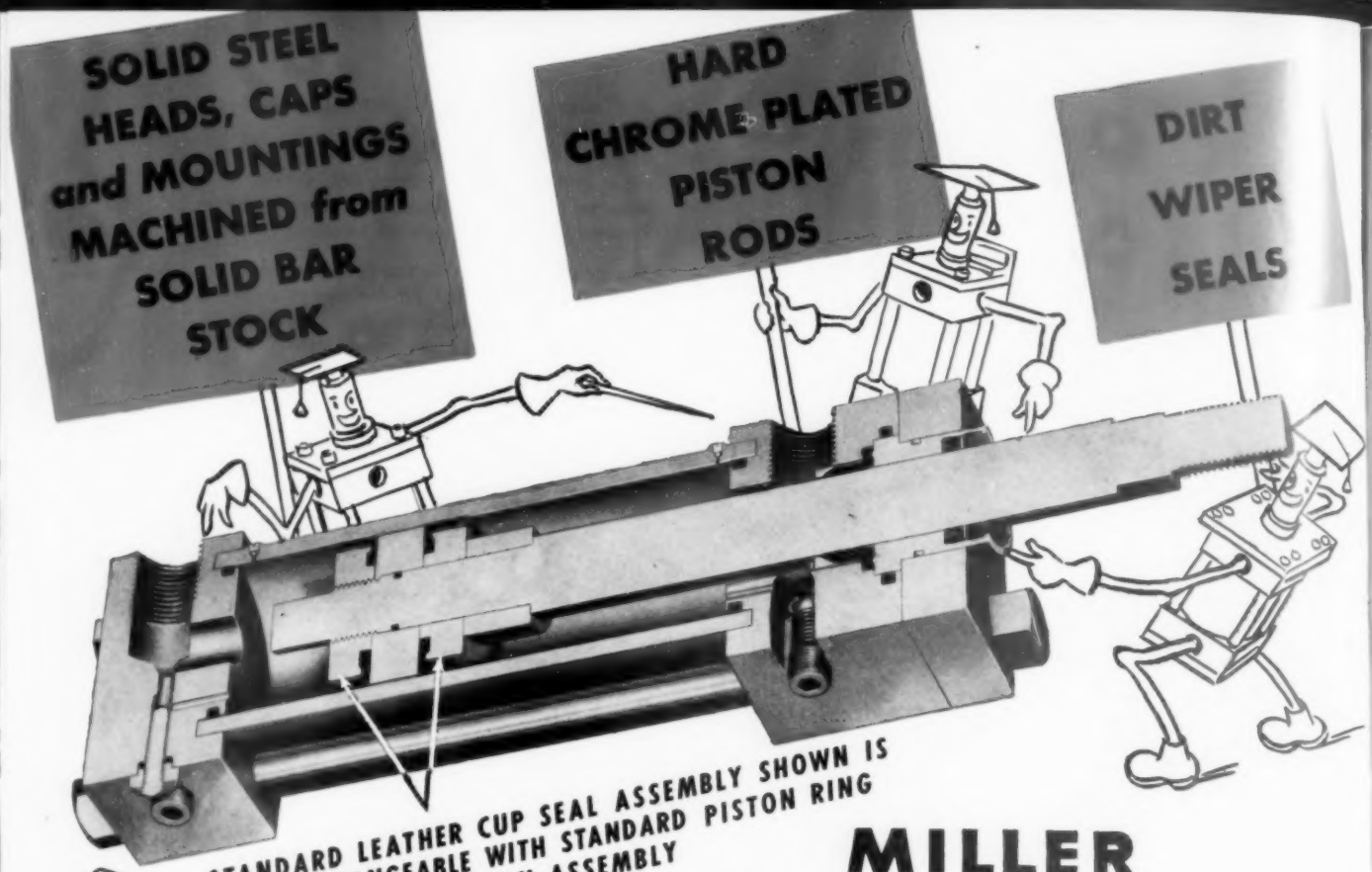

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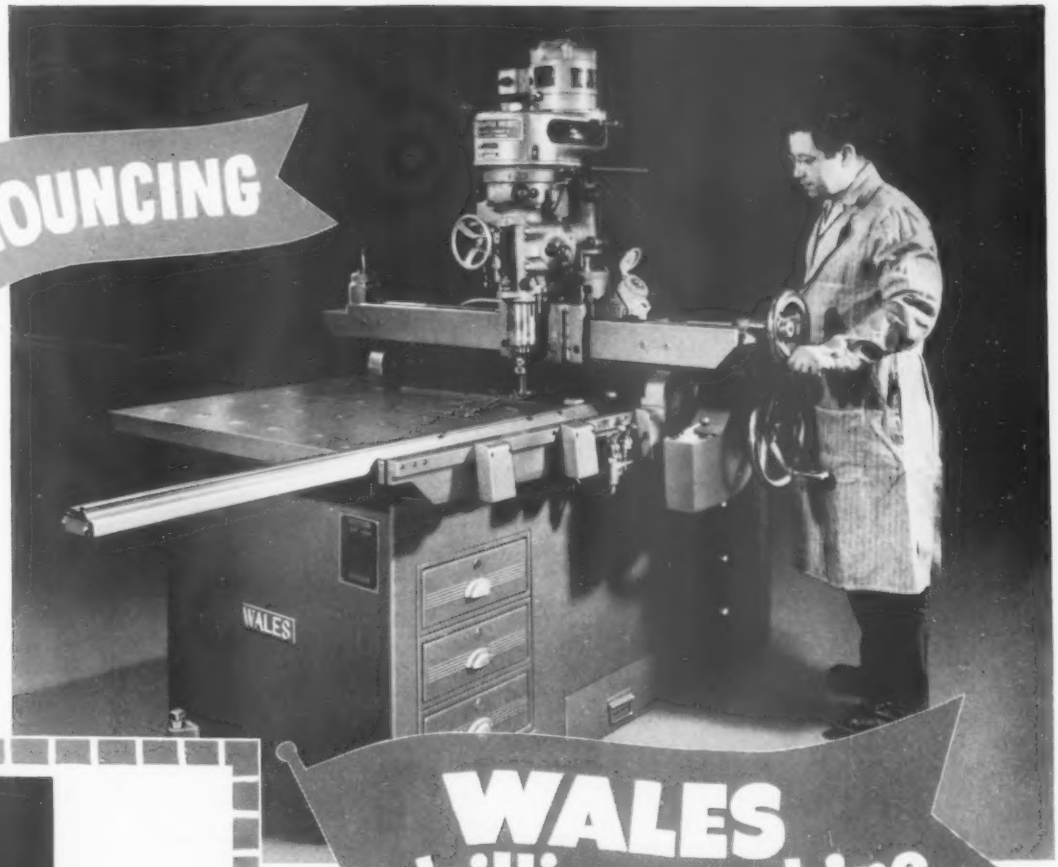
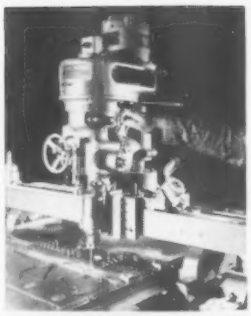
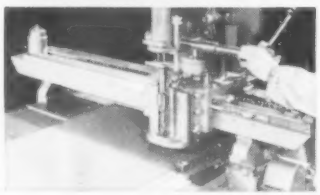


WALES drilling machine with new boring head



BORING

Close-up of boring operation on Wales Deluxe Model Drilling Machine.



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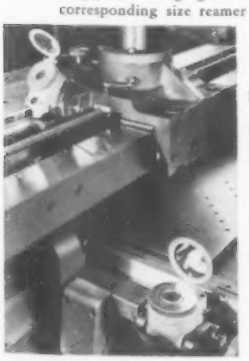
Showing a hole in the work being reamed by simply interchanging the drill and bushing with corresponding size reamer and reamer bushing.



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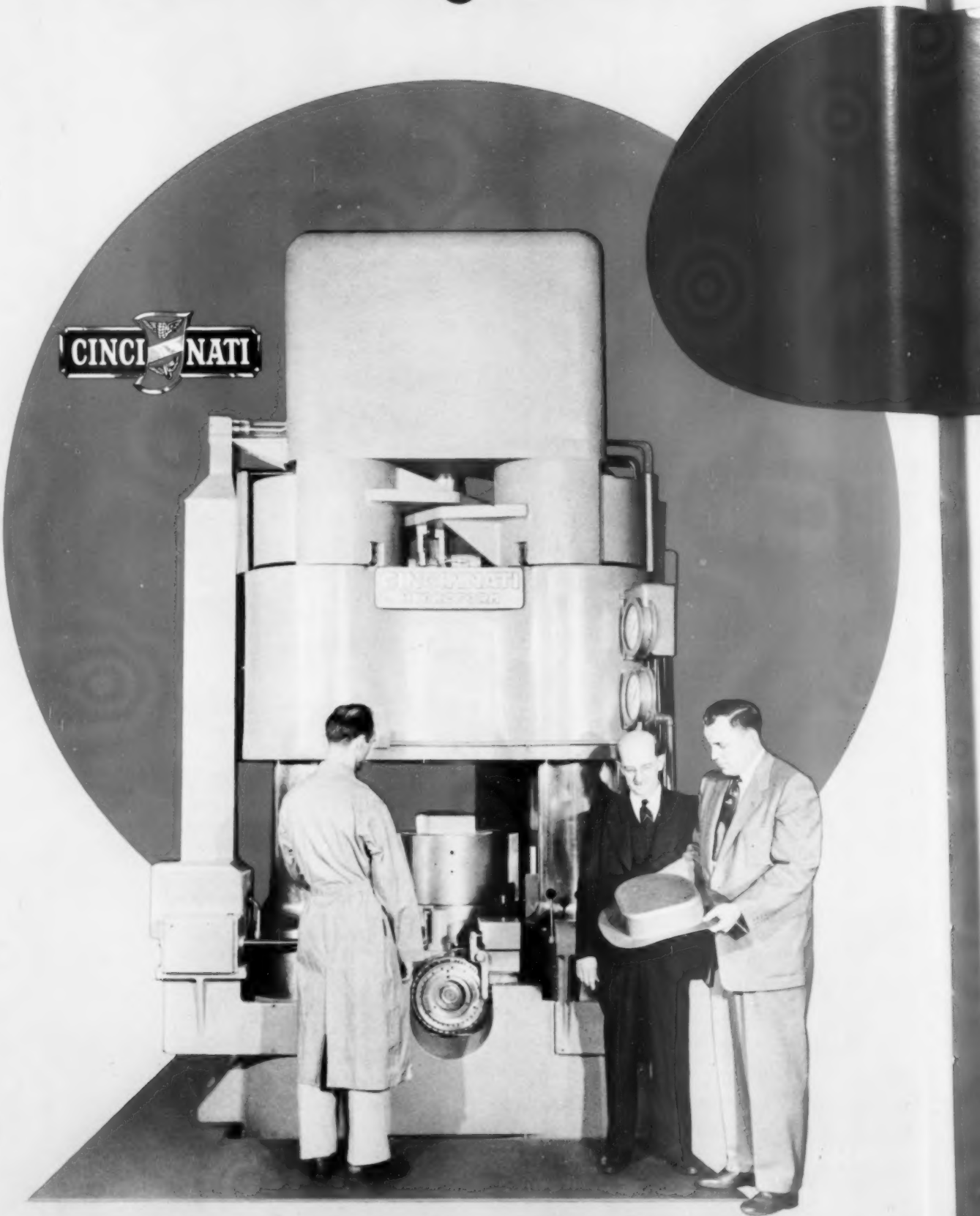

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In this legend there's a lesson

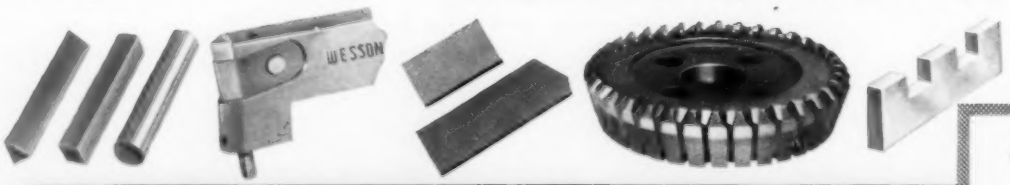
"The seat is his! All honor to the Ironworker," said Solomon when, at the dedication of the Temple of Jerusalem, an Ironworker chose the seat of honor next to Solomon's throne.

Solomon voiced this opinion, when the artisans who built the Temple, and who had been invited to its dedication, objected violently to the Ironworker even being there.

When Solomon insisted the Ironworker have a chance to speak, the Ironworker said: *"Without my metal working skill these men would not have had the tools with which to build this Temple."*

Improvements in today's products depend on improvements in metal working tools.

Tool Holders, Face Mills, and other tools with replaceable Wesson-metal tungsten carbide blades and inserts are typical of the many Wesson tools that offer superior features to improve your production.



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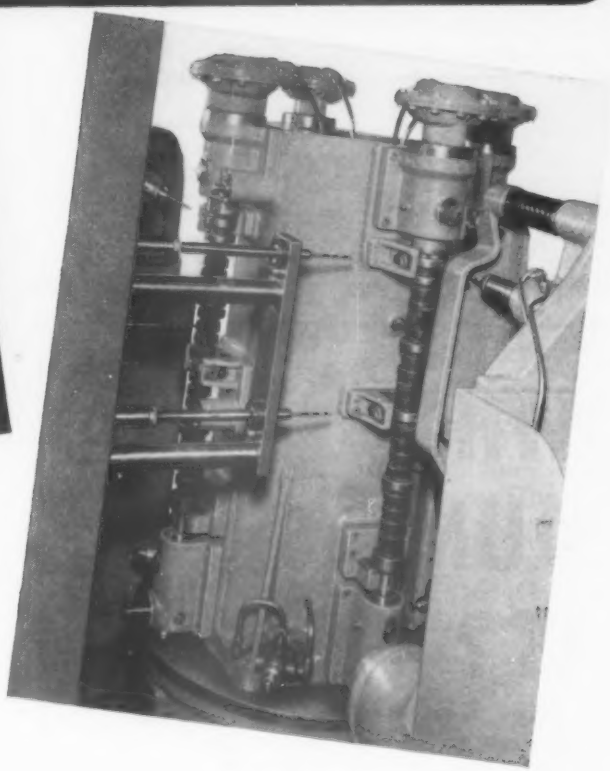

Above, four automotive connecting rods have both sides of crankshaft bore chamfered simultaneously. At right is shown one machine drilling four oil holes for camshaft journals and milling keyway for timing gear on automotive camshaft. Both machines illustrated utilize automatic clamping.

When it comes to production

HARTFORD *Special*

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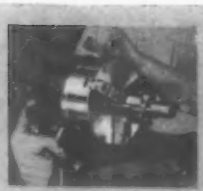

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THE HARTFORD SPECIAL MACHINERY CO., HARTFORD 12, CONN.

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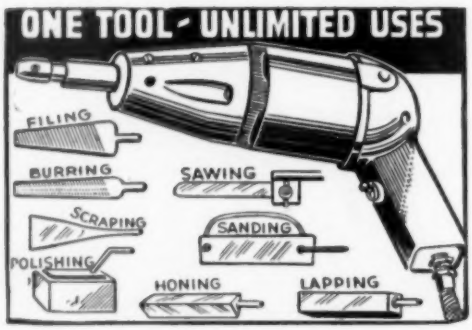

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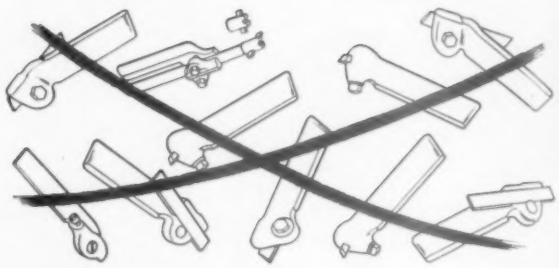

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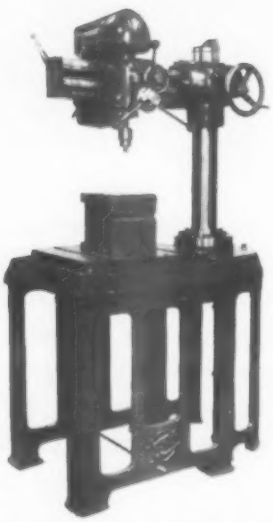

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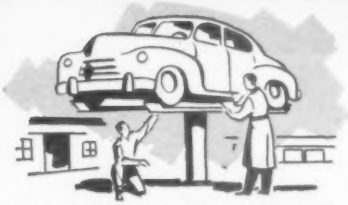
Whether you need a one-of-a-kind special or machines to be built in quantity for resale, it will pay you to explore the possibilities of Hannifin "Hy-Power" Hydraulics. For here is equipment that permits you to apply forces up to 100 tons . . . in any direction . . . simultaneously. A Hannifin Field Engineer will explain how you can utilize this modern equipment for punching, riveting, staking, bending or crimping operations. Hannifin Corporation, 1119 S. Kilbourn Ave., Chicago 24, Ill.



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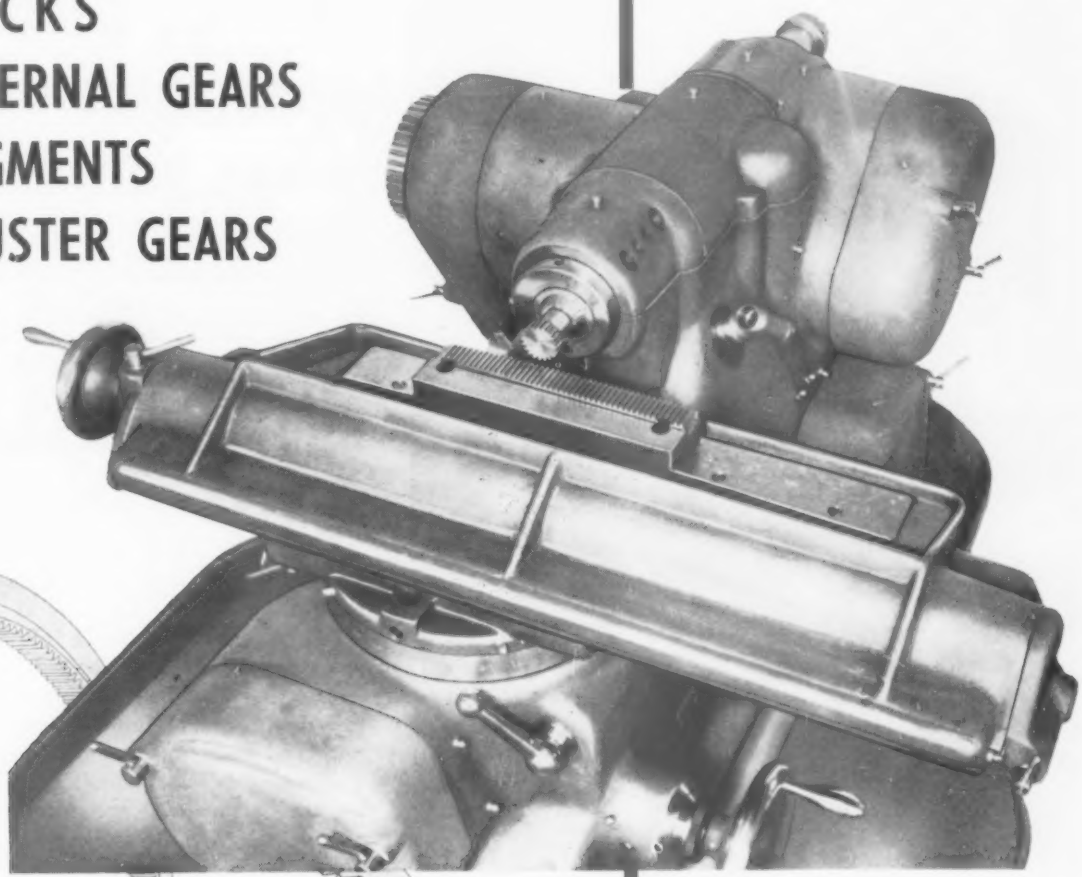

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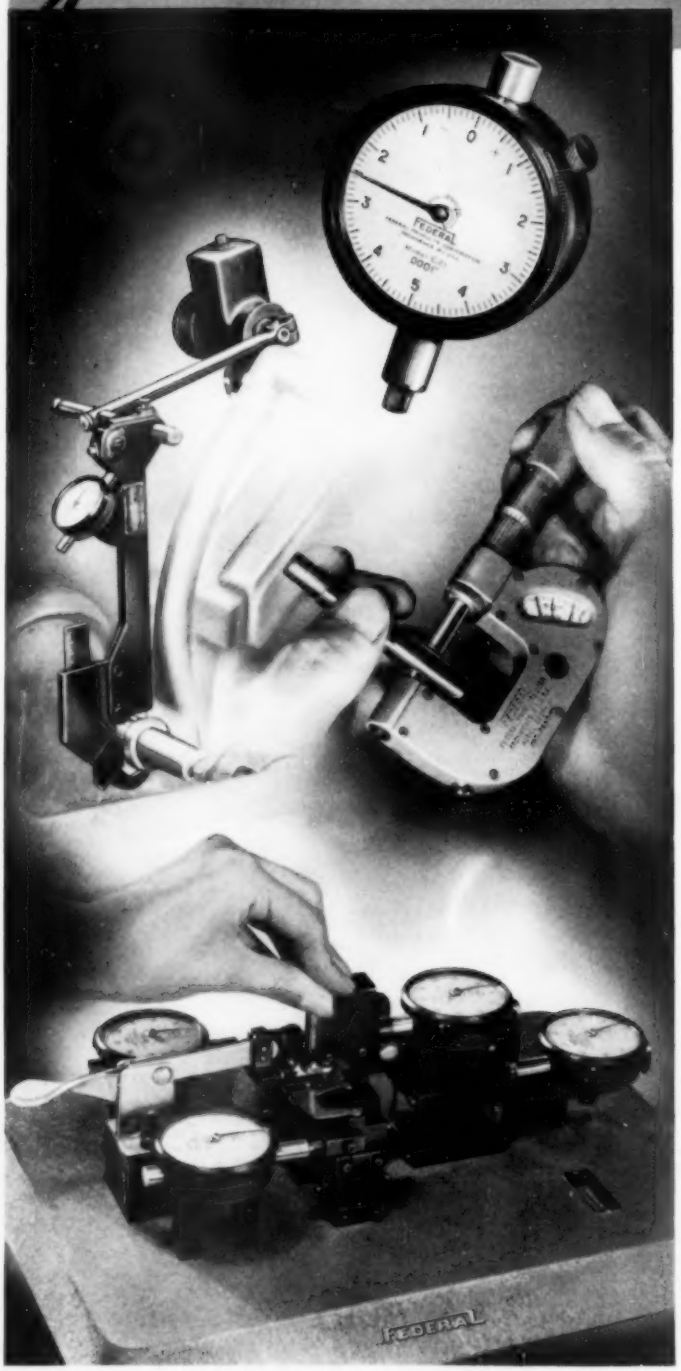

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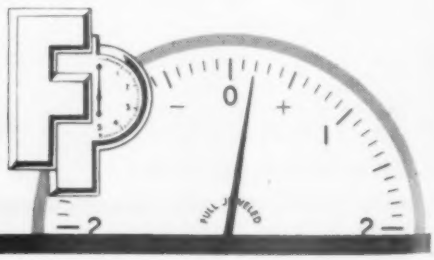

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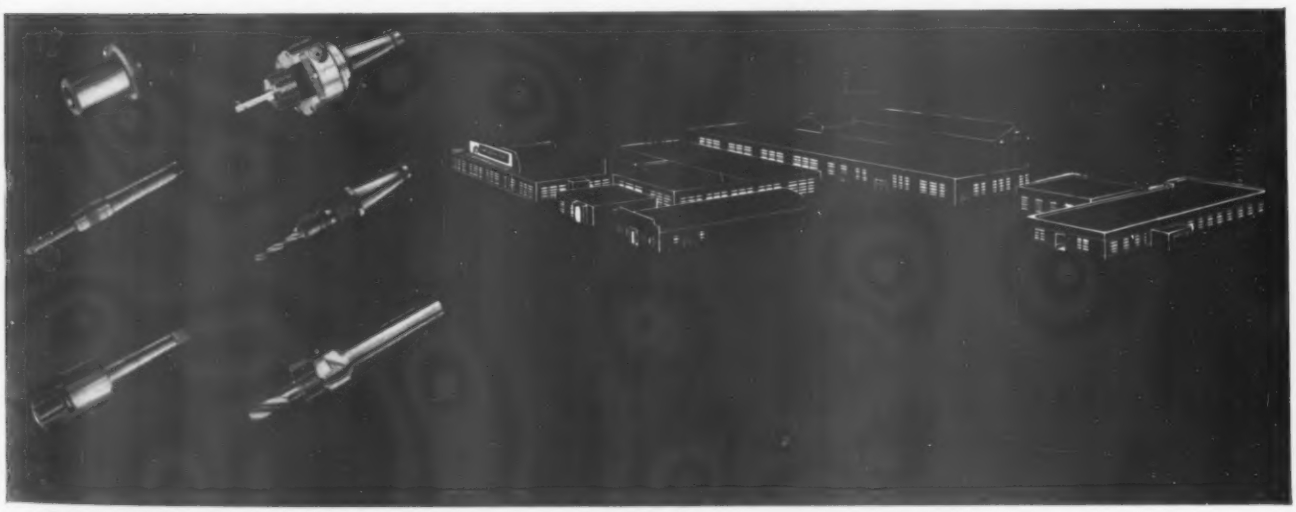

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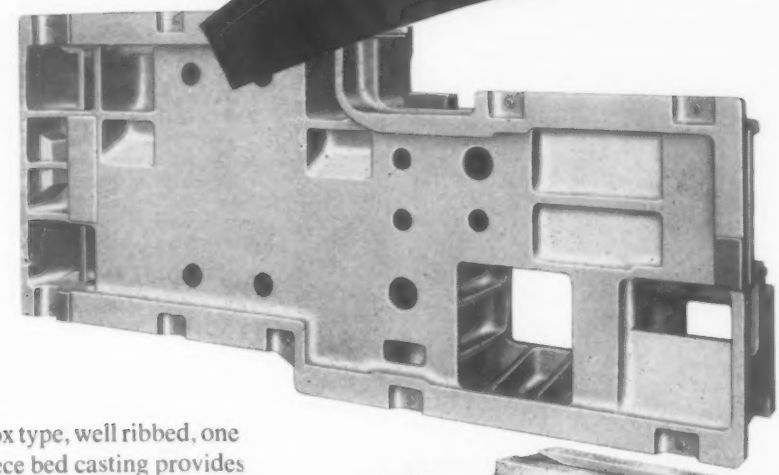

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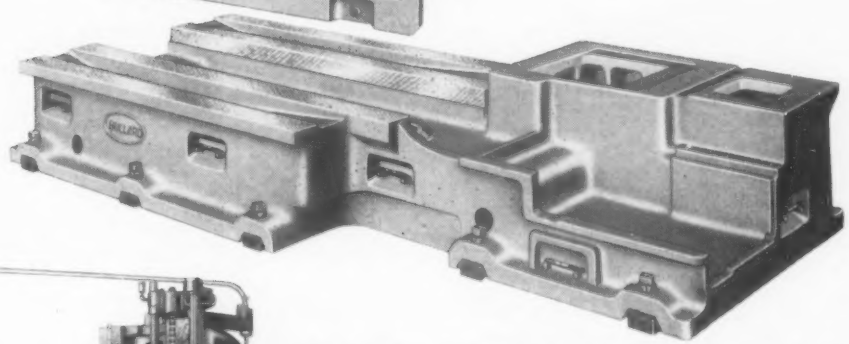

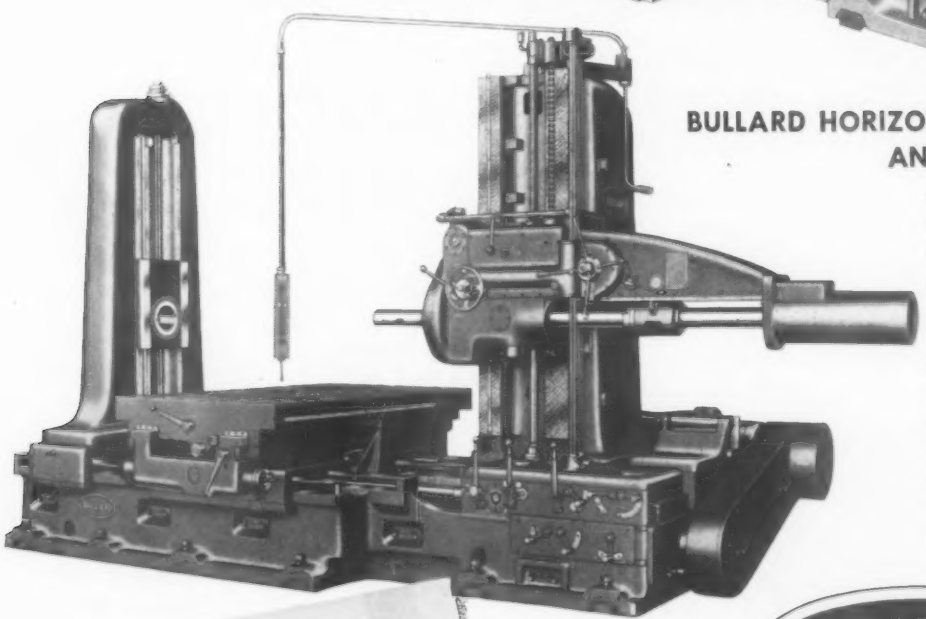

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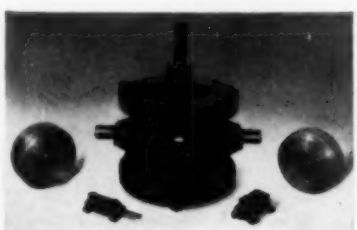
For this help, call today or write Anker-Holth Division of The Wellman Engineering Company 2727 Conner Street, Port Huron, Michigan.

Above: Anker-Holth Model HH Hydraulic Cylinder installed on a Gardner Grinder.



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Let us quote on your tool requirements. You'll save money . . . even as compared with "home made" tools. Standard circular form tools for B&S and Davenport Machines carried in stock. Immediate delivery.

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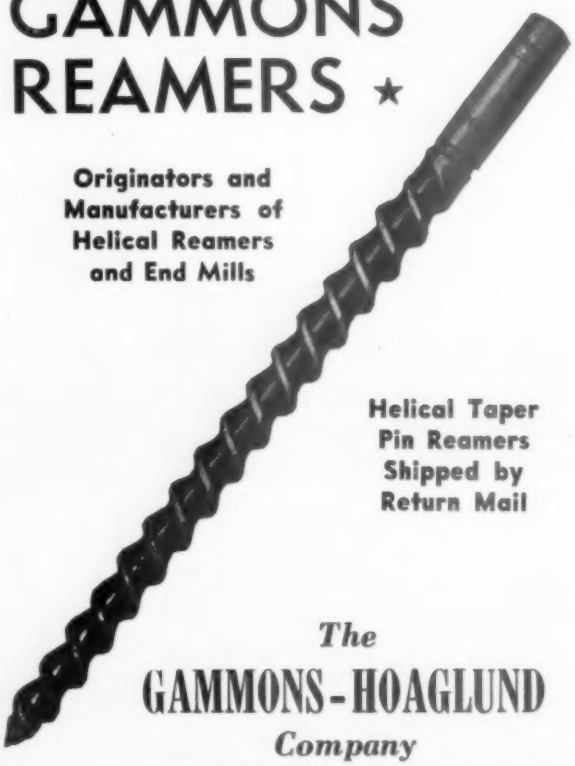

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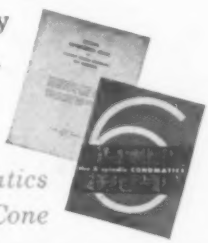
WHY NOT HAVE THE FIGURES?

Front Side of Tooling Area
Rear Side of Tooling Area

If you have a tough forming job in mind for a new "automatic," it's more satisfactory to know the recommended maximum load of the proposed machine's cross slides than to merely be told that they are *rugged.*

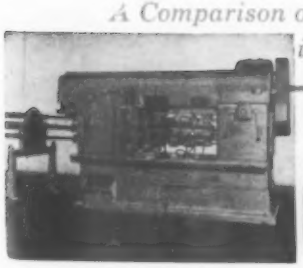
Before a machine can satisfy an important requirement it must be *built that way.* And built to figures instead of adjectives.

There are many factors involved in the building of any brand of Multiple Spindle Bar Automatic, factors on which you may want the figures. You may have the figures on CONOMATICS.



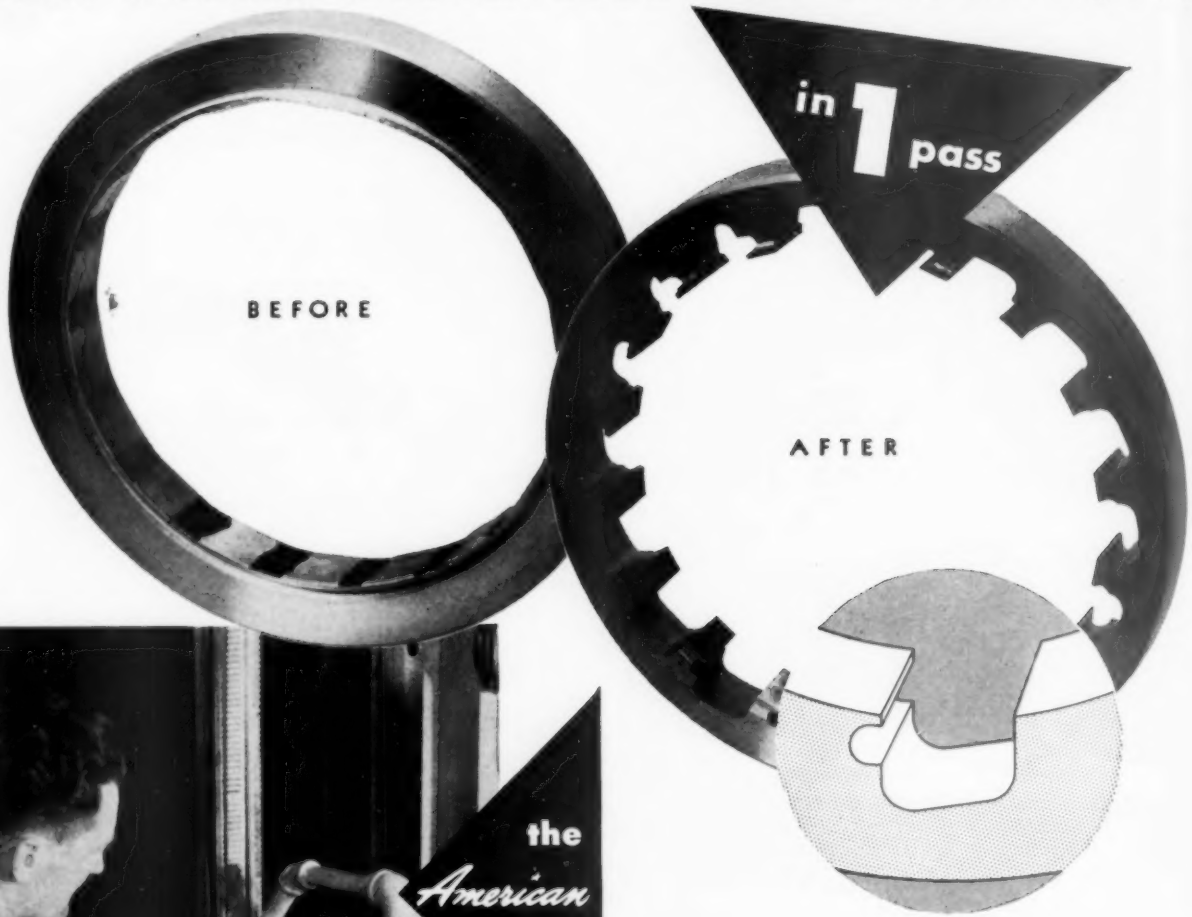
A Comparison of ALL Automatics
is in Favor of Cone

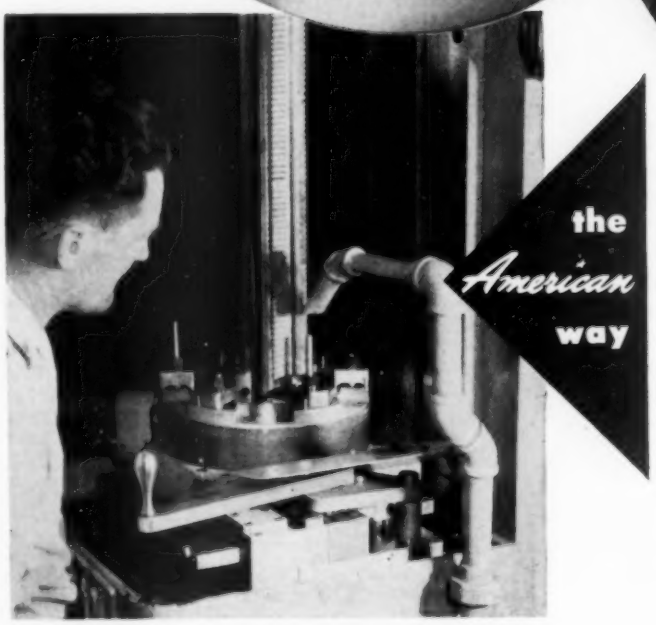
In producing the alloy steel part shown, the maximum load recommendation for each main cross slide of the 3½-SIX is 8,000 foot pounds. The total net weight of the main cross slides is 825 pounds.



Conomatic } CONE AUTOMATIC MACHINE COMPANY, INC. WINDSOR, VT., U.S.A.

This intricate form broached accurately...





This is only one example of how American designs broaches, machines, and fixtures to save time, labor and machine operation costs. You can get these advantages too, by sending a part-print or sample and hourly requirements to the organization that builds all three . . . broaches, machines and fixtures. Write Dept. T today! No obligation.

An American Vertical Hydraulic 72" stroke machine was equipped with special tooling to broach the 18 slots and adjacent undercuts in a stator ring in 18 passes — these slots being held accurately with respect to form as well as location.

The machine has a hardened and ground broach holder carrying two broach sections which are guided through the fixture base in hardened and ground guides. The manually operated index fixture mounted on a cross slide moves the part in and out of broaching position. This provides clearance for the broach and holder assembly and permits unloading and reloading of the part as well as indexing of the fixture.

The broach inserts mounted side by side rough broach two slots simultaneously and finish respectively a cam surface in one slot and adjacent undercut in the other. 18 slots are broached in 18 passes to complete the operation, the slots being broached to a depth of approximately .500.

Write for circular No. 300

AMERICAN **American BROACH & MACHINE CO.**

A DIVISION OF SUNDSTRAND MACHINE TOOL CO.

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American First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

42 SECONDS—FLAT!
. . . a new threading record
for the CRI-DAN "D"
Product: Diesel Engine Stud
Size: 2½" Diameter; 2½" Thread Length; 4-pitch thread
Material: 4150 S.A.E. Steel 30-32 Rockwell "C"

Here's another example where the fabulous Cri-Dan "D" threading machine licked a tough threading job in *seconds* that would have normally taken *minutes*.

This time the part was a Diesel Engine Stud, 2½" in diameter in which a 4-pitch thread 2½" long had to be cut in 4150 S.A.E. steel.

The well-known company* doing the job reports phenomenal results in accuracy as well as speed using the Cri-Dan "D" with a single carbide tipped tool.

Whether you have an unusually tough threading problem where accuracy is at a premium, or a threading operation you'd like to speed up, by all means check with your Lees-Bradner representative and get the facts on the Cri-Dan "D".

*Name on Request

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13/64	1.80	15/16	2.25	29/64	3.60
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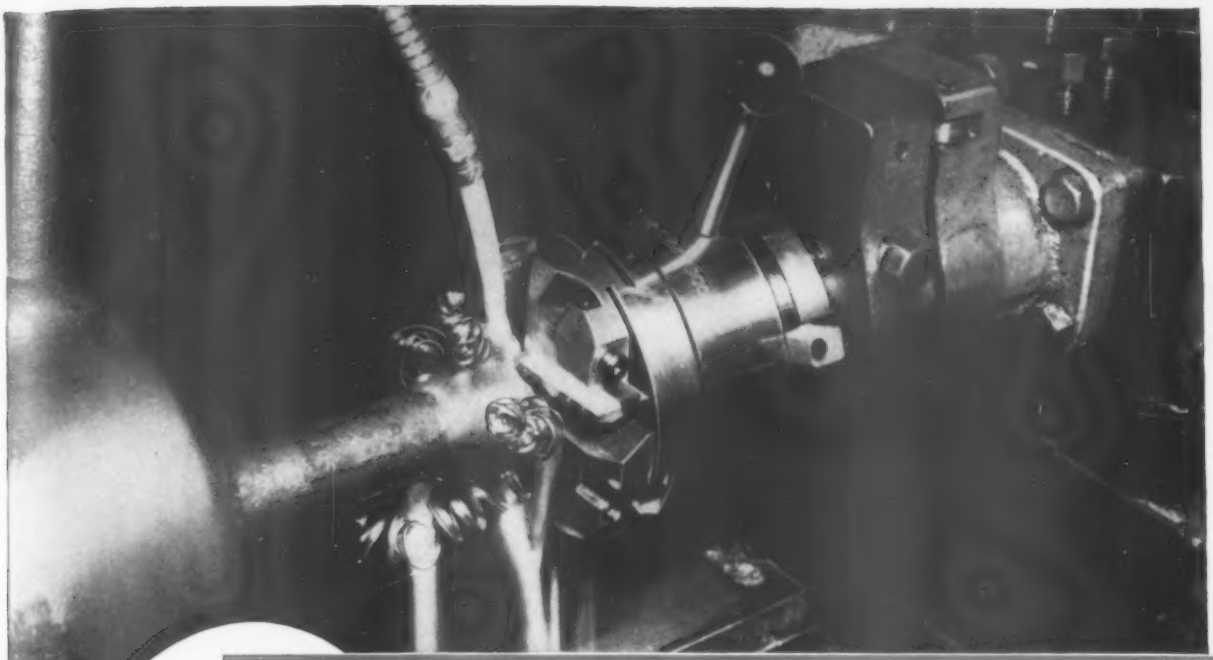

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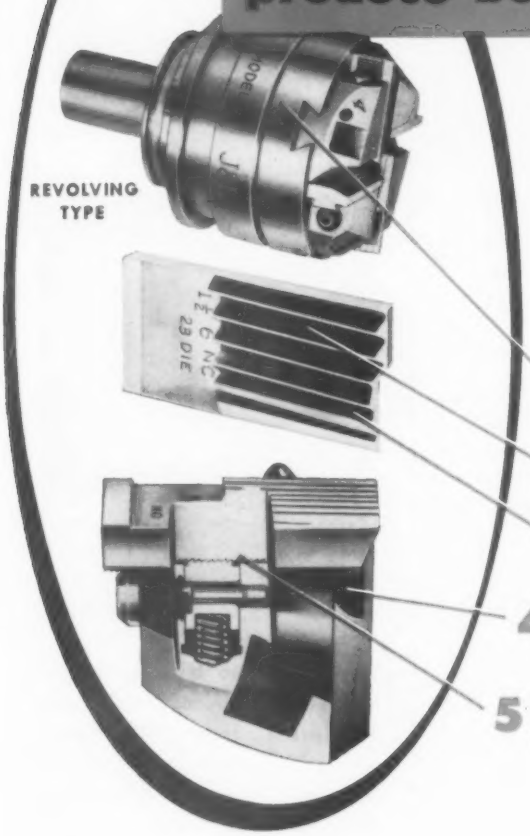
WITH GROUND THREAD TANGENT CHASERS

produce better threads at lower cost!



J&L Tangent Chaser Die Heads are rugged, dependable, time-tested tools. They are production engineered to produce better threads at speeds limited only by the material being threaded. Capacities are from #4 to 2".

There is a J&L Tangent Chaser Die Head engineered for your requirement. Stationary types are available for turret lathes or any machine where the tool does not turn. Revolving types are for automatic screw machines, drill presses, threading machines, or any machine where the tool is held in a live spindle.

Among the many features contributing to their ability to perform your threading job faster and better are these:

1. They are hardened and ground throughout. The chaser holding blocks are precision lapped for perfect fit into the dovetail slots in the body. Chaser cutting edges are held to a minimum distance from the die body.
2. Chasers are guaranteed to produce threads to Class #3 fit or better.
3. Exact helix angle is ground into the chasers after hardening. The result is a freer cutting tool—operating with a minimum of friction, heat and wear.
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5. Chasers are changed and set quickly and easily, giving you more production hours each day.

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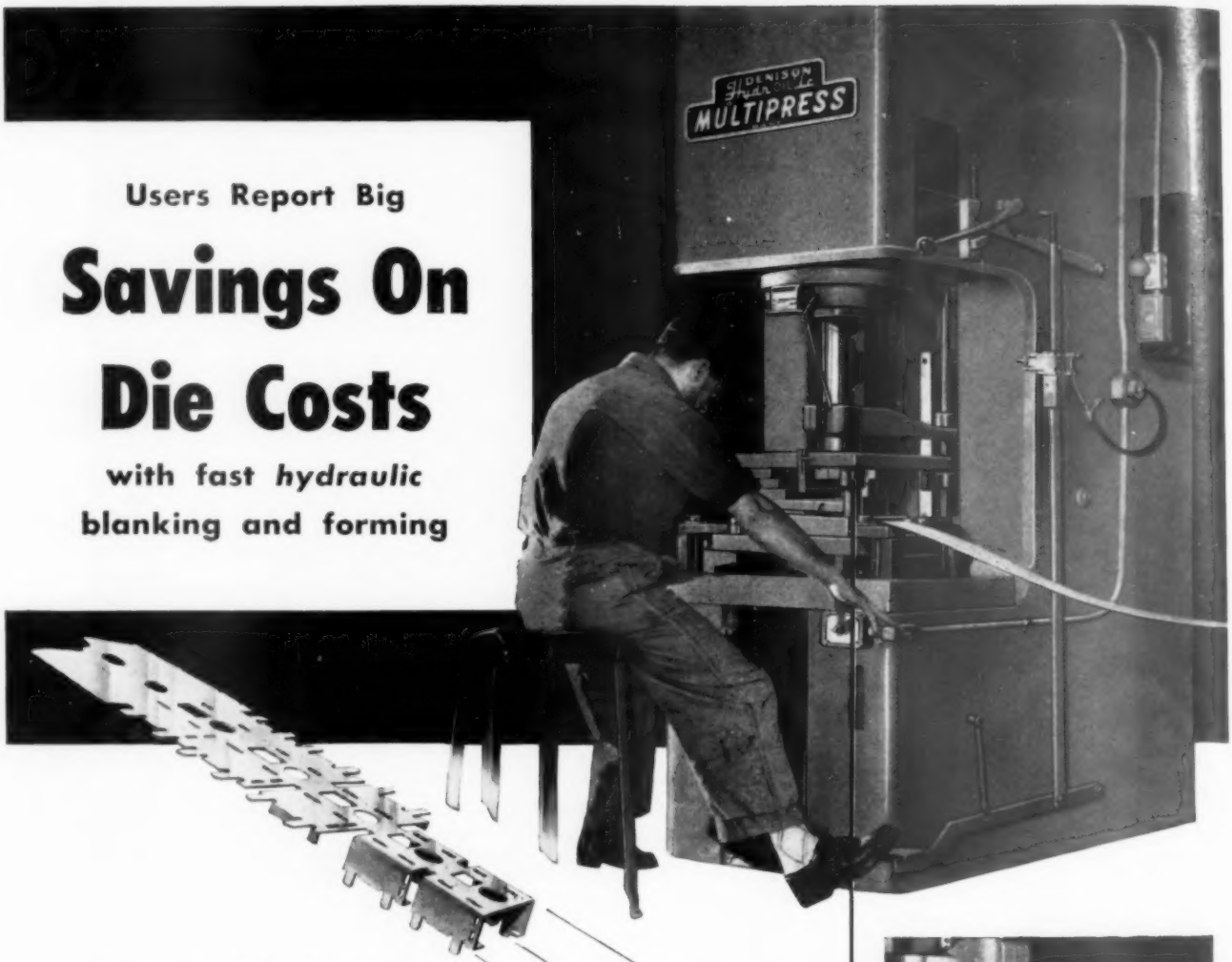

On a host of jobs from single-stage blanking to eight-stage compound and progressive blanking and forming operations, the Modern Venetian Blind Co. adds *lower die costs* to other production gains — with the smooth, oil-hydraulic action of Multipress.

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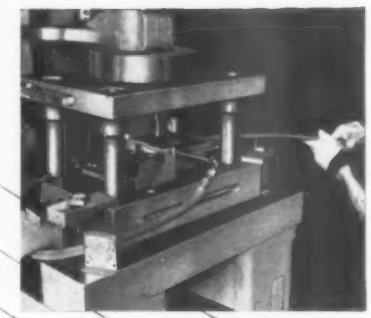
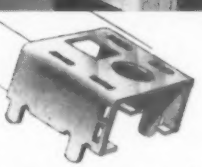
If you're looking for better, safer, high-speed ways to blank, form, pierce, draw, flare, broach, trim, bend, stake, swage, rivet, stamp, mark or press-fit, you'll want full details on Multipress. Eight frame sizes. One-ton to fifty-ton capacities. Manual or automatic controls. Ram actions to suit any need. Write today.





Typical part blanked and formed on progressive dies by Multipress, from .030 gauge pre-painted strip metal, at Modern Venetian Blind Co., New Bedford, Mass.

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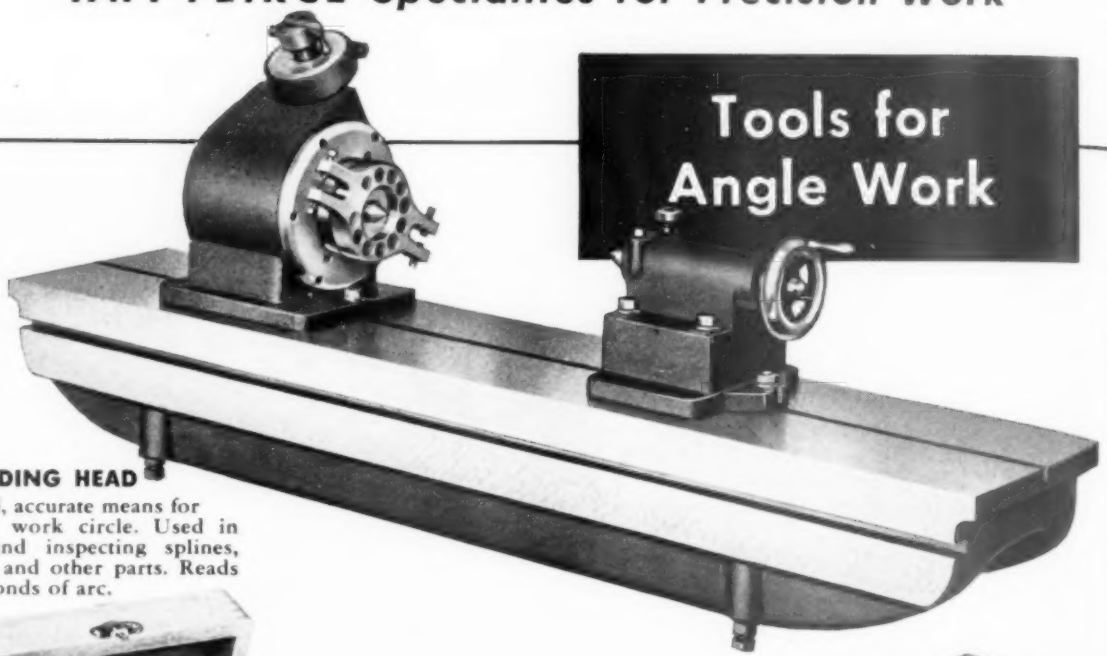
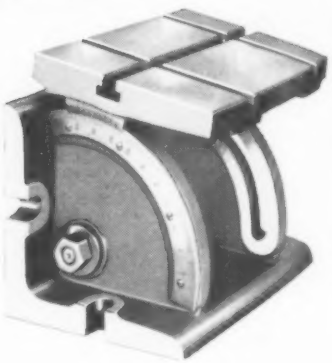


T-P DIVIDING HEAD
offers a rapid, accurate means for dividing the work circle. Used in measuring and inspecting splines, gears, cams, and other parts. Reads within 6 seconds of arc.

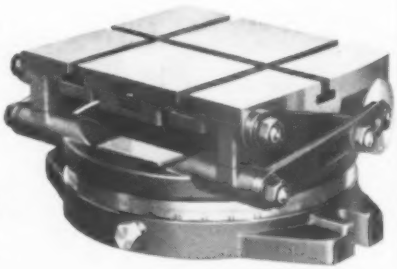
T-P SINE BARS & SINE BLOCKS
First conceived and built by Taft-Peirce, they locate work to any given angle within very close limits. Tapped holes permit clamping.

T-P TOOLMAKER'S ADJUSTABLE KNEE
simplify inspection or setup of angular work. Graduated quadrant and vernier reads to 5 minutes of angle.

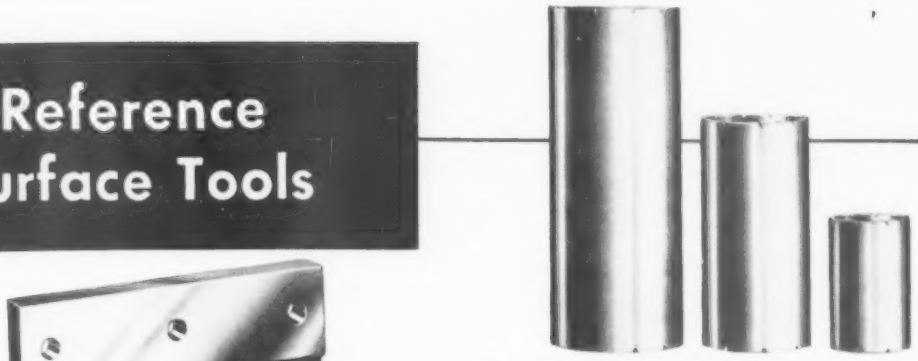


T-P ANGLE BLOCKS
speed setup and grinding of small angular work on a magnetic chuck. Can be used individually or in any combination to form V-blocks.

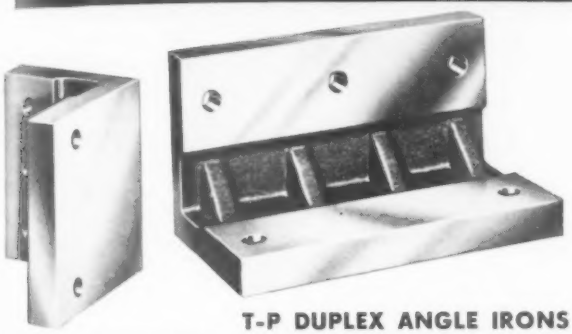
T-P ADJUSTABLE ANGLE PLATE
tilts and turns. Makes compound angles easy to setup for machining. Both tilting table and rotating base are graduated from 0 to 90 degrees in each direction.



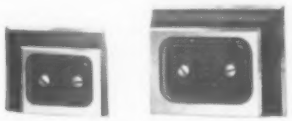
Reference Surface Tools



T-P CYLINDRICAL SQUARES
Used with T-P Surface Plate they provide a convenient, accurate reference line for any vertical work-surface.



T-P DUPLEX ANGLE IRONS
Finished inner pads increase accuracy, permit faster setups. Other types available include Slotted Angle Irons, Universal Right Angle Irons, Toolmaker's Knees, and Measuring Irons.



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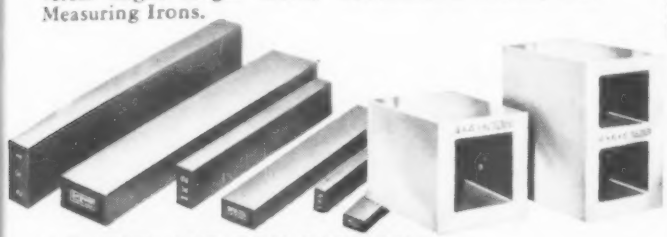
High precision squares that can be used in any position. Hard rubber center facilitates gripping . . . prevents hand heat from reaching block.



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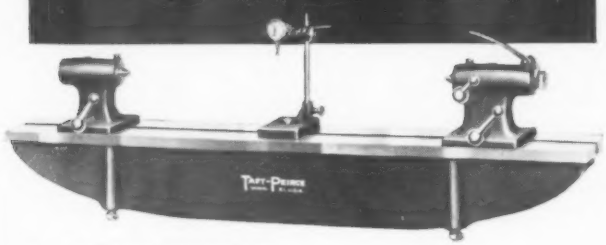
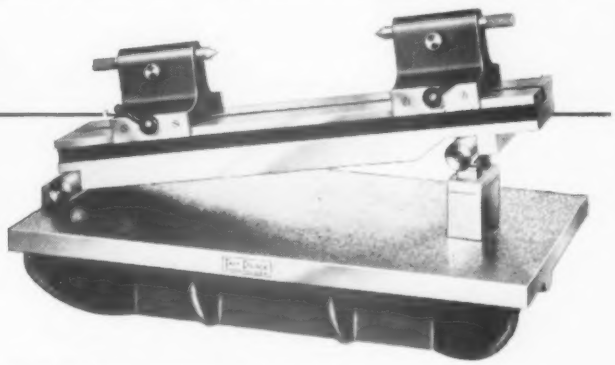


T-P BENCH CENTERS
simplify inspection work. Have unusual rigidity and permanent accuracy. This is typical of a wide range of inspection tools available at Taft-Peirce.



T-P TAPER TESTING FIXTURE
combines a Sine Block with a pair of adjustable mounted precision centers. Checks tapers to high degree of accuracy.

For the complete story on these items and many more, get your copy of the Taft-Peirce Handbook.

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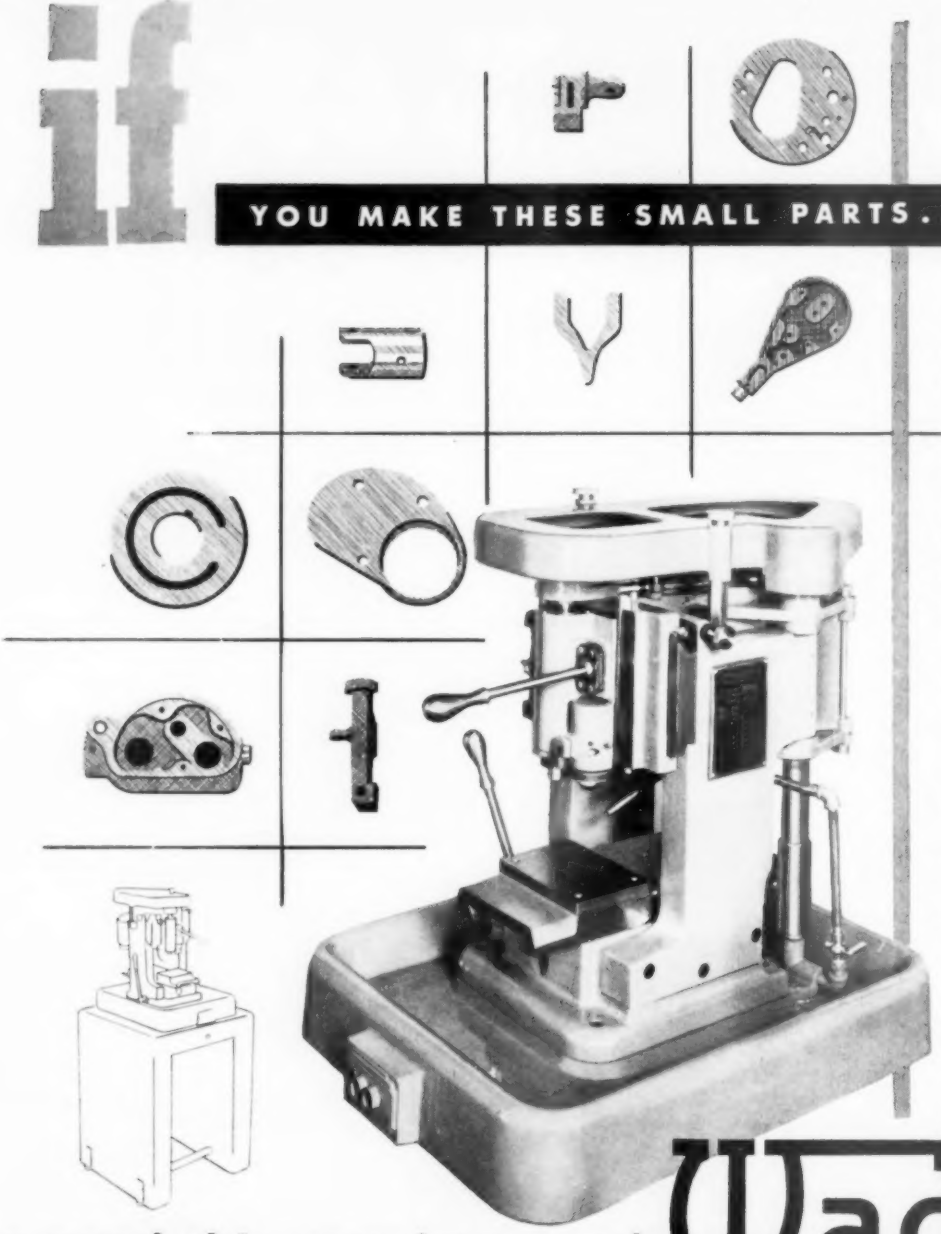

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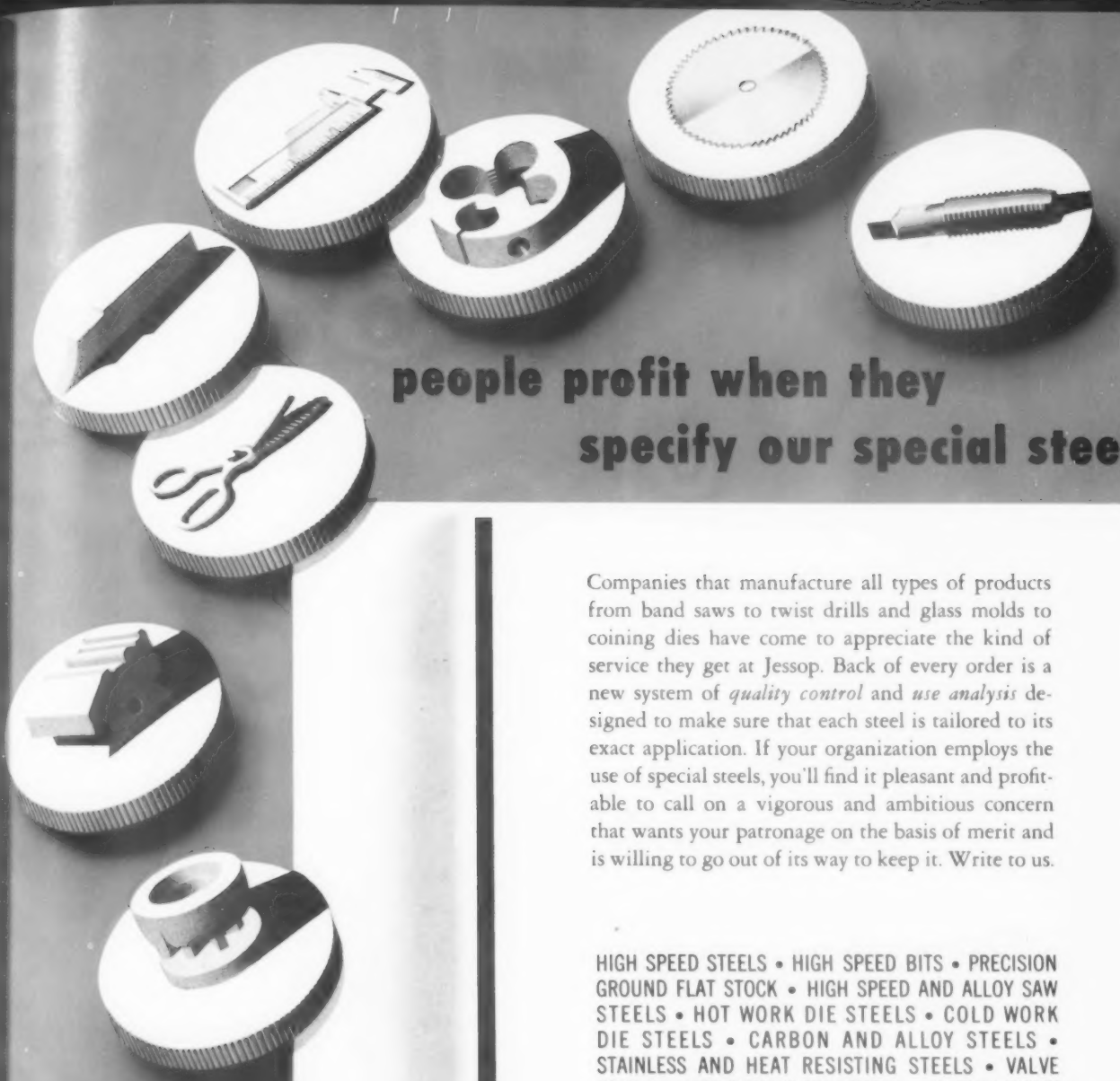

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• *The No. 11 Warner & Swasey Precision Tapping and Threading Machine. Capacity 8-36 to 7/8". Other models from 0-80 to 2½".*

A WARNER & SWASEY Precision Tapping and Threading Machine solved a tough tapping problem for a large New Jersey electrical manufacturer—*and cut cost 74%!*

The job was to tap twenty-four 3/16" 18-pitch Class 3 Threads in large steel rings 48" in diameter. Because a spoiled thread on any of the 24 holes would scrap the job, it was formerly broken into two operations—rough tapping by machine; finish tapping by hand. Tapping cost was high—$23.00 per hundred.

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The continuing accuracy of the exclusive Warner & Swasey lead screw principle using solenoid actuated guide fingers is responsible for the success of the Precision Tapping and Threading Machines on this and hundreds of other tapping and threading jobs calling for Class 3 and 4 fits.

If you're not yet familiar with this machine and its many new design features, let a Warner & Swasey Field Engineer tell you about it. In many plants it pays for itself in increased tap life alone, in addition to effecting better production and cutting scrap losses far below former standards. Write for a catalog covering all models.

WARNER & SWASEY
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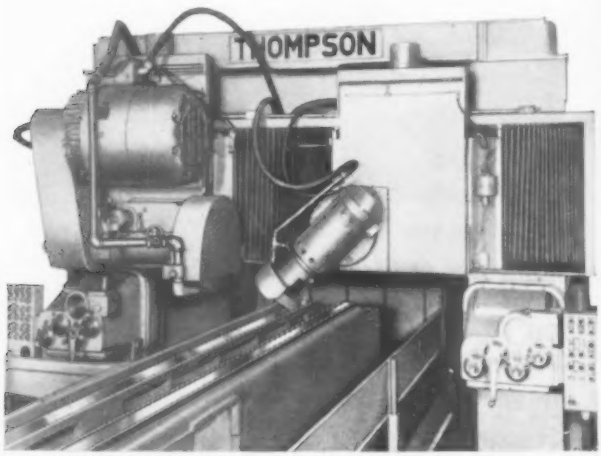
New Thompson Way Grinder Developments

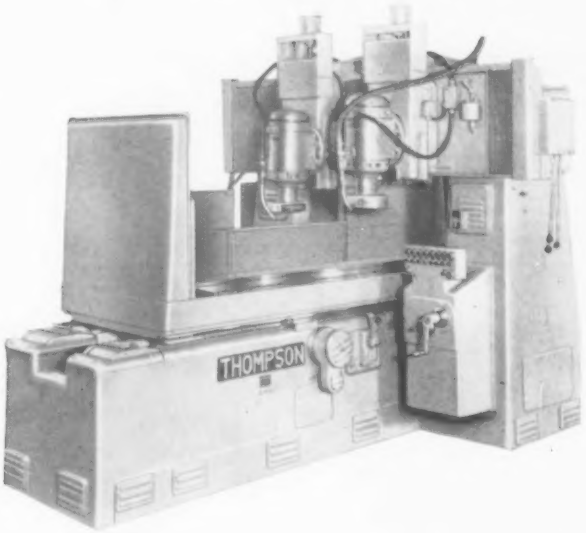
Reduce Costs ... Speed Machine Tool Production

Way Grinders now available with single, multiple heads, or combinations of horizontal and vertical heads and in sizes to meet all requirements.

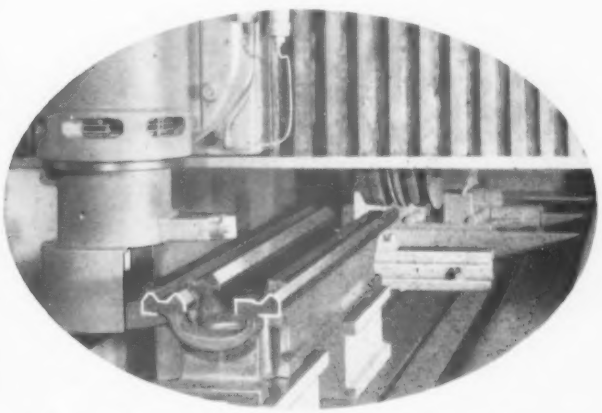
Thompson has produced machine tool way grinders in many types and sizes that have eliminated hand-work and produced economical and accurate ground ways. However, recently increased production grinding of ways has been made possible by many new Thompson Way grinding developments such as: automatic grinding and truing cycles; dual vertical or horizontal heads for grinding ways different heights; horizontal multi-wheel grinding and vertical side and undercutting head; Hydrail way grinding for giant columns or bed ways. Three of the new Thompson Way Grinders are shown here.



Designed especially for extremely large machine tool way grinding is this typical Thompson Hydrail Way Grinder. Size 48" x 48" x 192". Part: grinder bed ways.



One of several new Thompson Double Head Dovetail Way Grinders installed to speed work and hold accuracy in the plant of a leading lathe manufacturer.



Multi-wheel grinding with auxiliary vertical head. Equipped with horizontal spindle having dual spaced wheels and auxiliary inclinable spindle. The front contoured grinding wheel grinds the rear set of ways and the rear grinding wheel grinds the front set, with vertical head grinding the sides and undersurface of the ways and rack seat.

Write for details Today.

Thompson SURFACE Grinders

The Thompson Grinder Company, Springfield, Ohio

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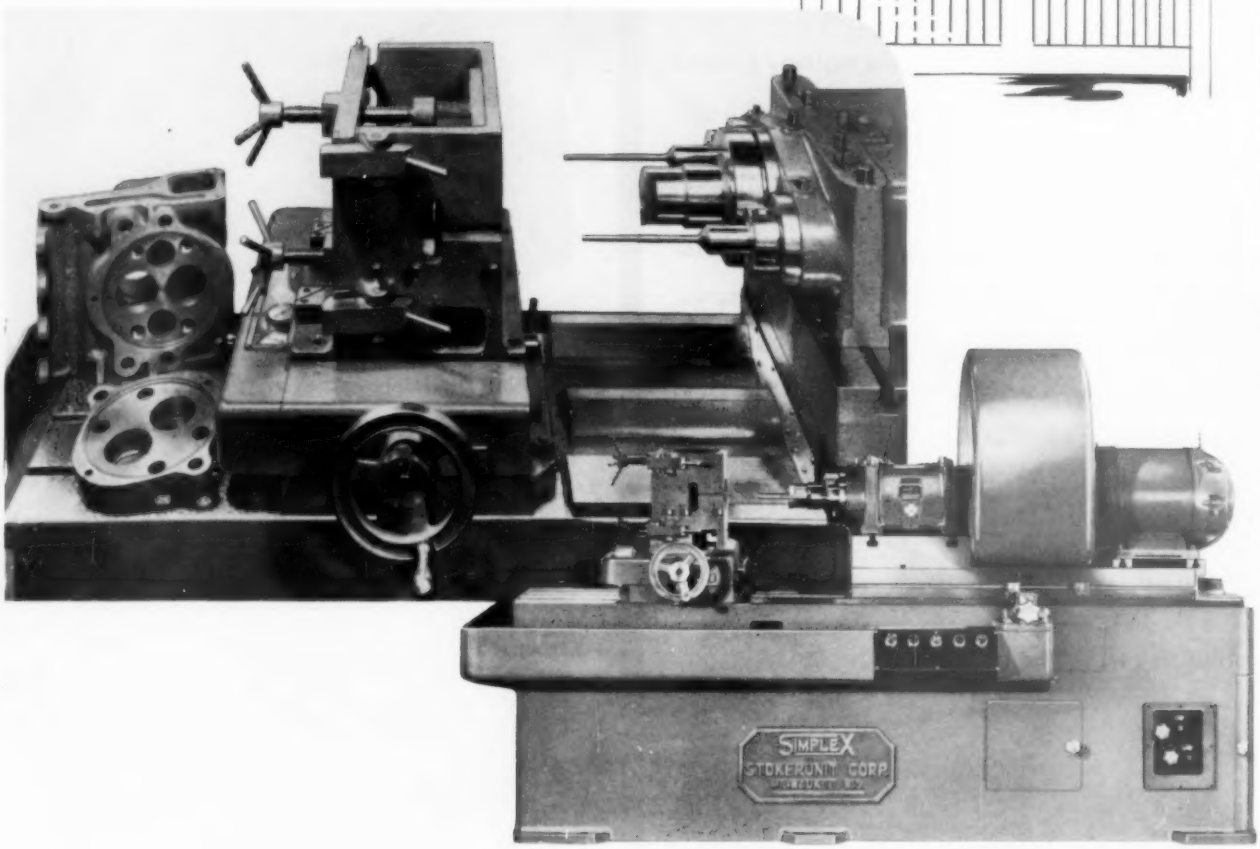

Machining dimensions and tolerances on oil pump bodies and component parts are accurately held and can be visually checked using the tooling supplied on the SIMPLEX 3U Single End Precision Boring Machine shown. Oil pump covers, bodies, and spacer plates are all machined using the same multiple spindle boring head designed to support tooling for boring both dowel holes and also the gear cavities in the various parts.

Simplex **PRECISION BORING MACHINES**

SIMPLEX MACHINE TOOL DIVISION

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PRECISION BORING MACHINES • PLANER TYPE MILLING MACHINES • SPECIAL MACHINE TOOLS

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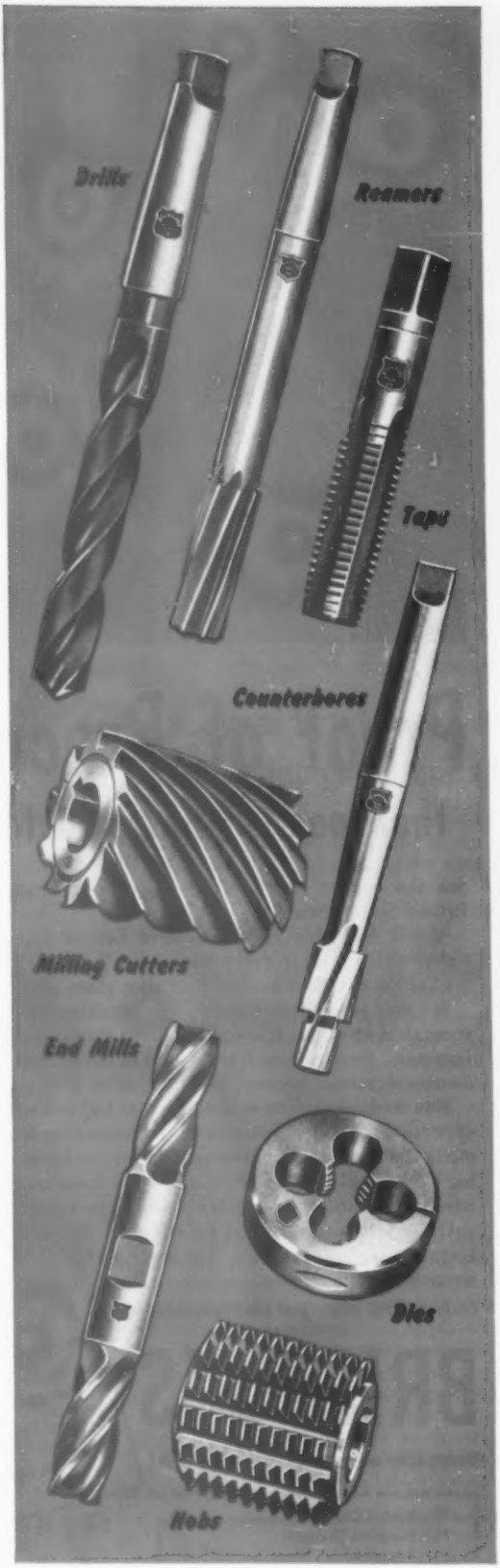
Serves Border to Border, Coast to Coast

COMPLETE, fast and accurate service on Shield Brand cutting tools is now provided for Texas and the Southwest through our new branch at Dallas.

Today, from five branches and our headquarters in Cleveland, we provide nationwide, an unexcelled Service of Supply on Shield Brand cutting tools.

Ask your local Industrial Supply Distributor for Standard Shield Brand Tools. They are Foremost Quality and promptly available.



STANDARD TOOL CO. 3950 CHESTER AVENUE CLEVELAND 14, OHIO

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STANDARDIZE AND SAVE WITH STANDARD RED SHIELD METAL CUTTING TOOLS. THERE IS A STANDARD DISTRIBUTOR NEAR YOU AND READY TO SERVE YOU.

Proof of Precision

that means tighter fastening!

See the unique multiple-spline socket in that large 1-inch Bristol Socket Screw.

You'll find this same exclusive Bristol feature (vital to *tighter* tightening) in every one of the 7,438 tiny No. 0 Bristol Socket Screws held in that 2 oz shot glass.

It takes precise machinery . . . painstaking effort . . . to make them that way. But it's worth it . . . to give you shock-resistant fasteners, precise enough to be used in electric razors, cameras, communications devices, instruments of all kinds.

The multiple-spline socket permits tightening beyond limit of ordinary screws . . . turns internal wrenching force into *rotary motion*, not expanding pressure. Hence, no bursting, no rounding out of socket walls—even in sizes down to No. 3, 2, 1, 0 wire size. *Result:* maximum resistance to vibration.

Other advantages: ideal for compact assemblies and hard-to-get-at fastening points. For disassembly, a reverse flick of wrench loosens the set.

Only BRISTOL *gives you the right socket screw for every application*

BRISTOL'S

Multiple-Spline and Hex Socket Screws...Cap and Set

SEND COUPON FOR FREE SAMPLES
—also helpful bulletins on designing compact, tight assemblies.

The Bristol Company
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Please send me free sample of Bristol's Multiple-Spline Screw and bulletins showing applications to:

NAME_____ TITLE_____
COMPANY_____
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CITY_____ ZONE_____ STATE_____
Screw Sizes_____
Our problem is mainly_____ VIBRATION ☐
COMPACT DESIGN ☐ FREQUENT TAKE-APART ☐

USE READER SERVICE CARD; INDICATE A-8-156-1

Confusing but not Amusing

Can't blame the little fellow! Even the best of us are sometimes confused by the many symbols ordinarily used for thousands of ASA Standard sizes. With ACE, however, you simply state your wants in original, unscrambled specifications, i.e.—I.D.—O.D.—Length—Type. That's the way to get just what you order every time. And the way to get your new, free ACE catalog is to write for Catalog 1101-2

ACE DRILL BUSHING CO., INC
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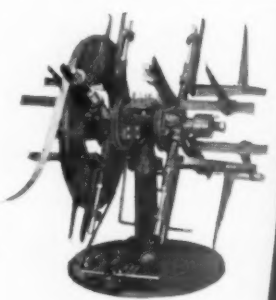
LESS DOWN TIME, MORE PRODUCTION FROM PUNCH PRESSES FED BY LITTELL DOUBLE AUTOMATIC CENTERING REELS



Vital minutes are saved, with practically no down time for coil replacement, when a Littell Double Reel uncoils stock to the punch press. The idle side of the reel is loaded while the other side pays out. When a coil is used up, the operator simply lifts the hub lock pin, then swivels the reel 180°, thus placing the reserve coil in press feeding position. The change-over is complete in a few seconds. Like Littell Single Reels, Littell Double Reels combine balance that means smooth running accuracy with rugged malleable iron and steel construction that assures year in, year out dependability.

FOUR SIZES
No. 3 . . . for coils up to 300 lbs.
No. 5* . . . for coils up to 600 lbs.
No. 10* . . . for coils up to 1,000 lbs.
No. 25* . . . for coils up to 2,500 lbs.
*Can be furnished with motor drive

Write for catalog

F. J. LITTELL MACHINE CO.
ROLL FEEDS • DIAL FEEDS • STRAIGHTENING MACHINES • REELS • AIR BLAST VALVES
4199 N. RAVENSWOOD AVE. • CHICAGO 13, ILL.
DISTRICT OFFICES: DETROIT, CLEVELAND

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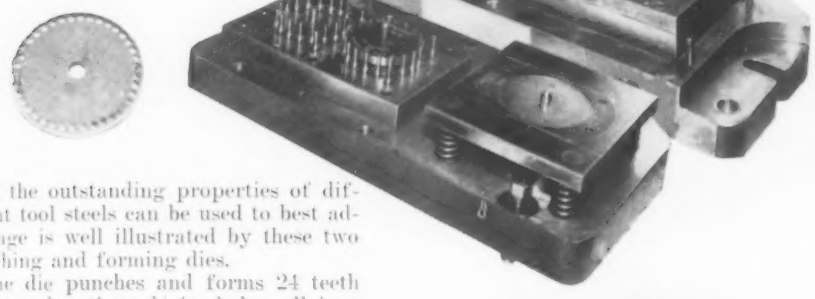
Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

BTR and LEHIGH H team up to form 24 teeth, punch 39 holes

In addition to punching 39 ¼-in. holes, this four-station progressive die also performs a blanking and embossing operation on 11-gage hot-rolled steel. About 25,000 pieces are produced before the die requires redressing. A sample piece is shown below.



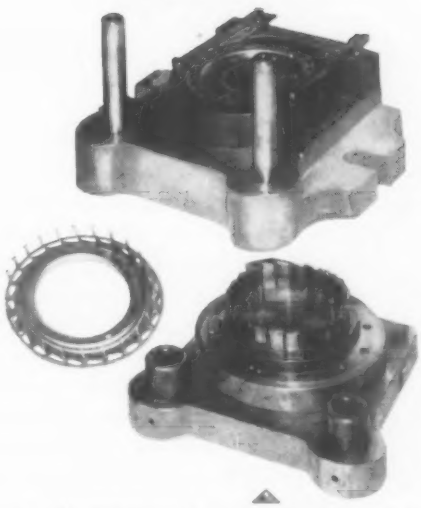
How the outstanding properties of different tool steels can be used to best advantage is well illustrated by these two punching and forming dies.

One die punches and forms 24 teeth and punches three ¼-in. holes, all in a single operation. The other die punches 39 holes of ¼-in. size, blanks out the piece, and embosses it.

The punches of both dies are made of BTR, our manganese-chromium-tungsten oil-hardening steel with a hundred and one uses. It has plenty of wear-resistance, and it takes the shock of the punching operation. BTR is easy to machine and heat-treat. And it's economical.

The die rings for both dies are made of Lehigh H, our general-purpose grade of high-carbon, high-chromium steel. This air-hardening grade is first choice wherever it's essential to have minimum distortion during heat-treatment. In addition, Lehigh H provides long-wearing properties for those long runs. You just can't get a better tool steel when you need accuracy and long wear.

Both these Bethlehem grades are stocked in popular sizes by Bethlehem tool steel distributors in principal cities everywhere, and in our mill depot.



This die punches and forms 24 teeth in 18-gage cold-rolled steel and punches three ¼-in. holes. About 50,000 pieces are produced before redressing.

METALLURGICAL SERVICE — Bethlehem metallurgists are on call whenever you have problems. They'll assist with the selection of tool steel, or its heat-treatment, forging, grinding, machining, design, etc.

Sometimes it takes more than just good tool steel

In a customer's plant the other day we asked the shop boss the name of the tool steel he used for a blanking die which we saw in his shop.

"Sorry, but I just can't tell you. All I know is, it works fine. We used to have a lot of trouble with that die . . . and then one of your Bethlehem men came in here one day. He worked with the die all day, and he cured the trouble for good."

Later we checked with the toolroom and found that the grade used for the die was BTR, our general-purpose, oil-hardening tool steel — and a mighty reliable one, too. The fact that the superintendent didn't know its name was probably a compliment. It was doing a good job. He no longer had to worry about it. So the name didn't matter.

The point is, it takes more than the best tool steel to make some tools and dies work right. Sometimes what counts most is the service that goes with the tool steel — our vast experience in applying each grade, the sales service, metallurgical service, and distributor service.

"Service" is often a glib promise, an intangible sales point. But we at Bethlehem look on service as an inseparable part of our product, something that goes along with every bar of steel we ship.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Special treatment often permits using carbon tool steel

We have run across several customers who use carbon tool steels for tools and dies that others would ordinarily make from oil- or air-hardening tool steels. This is real economy.

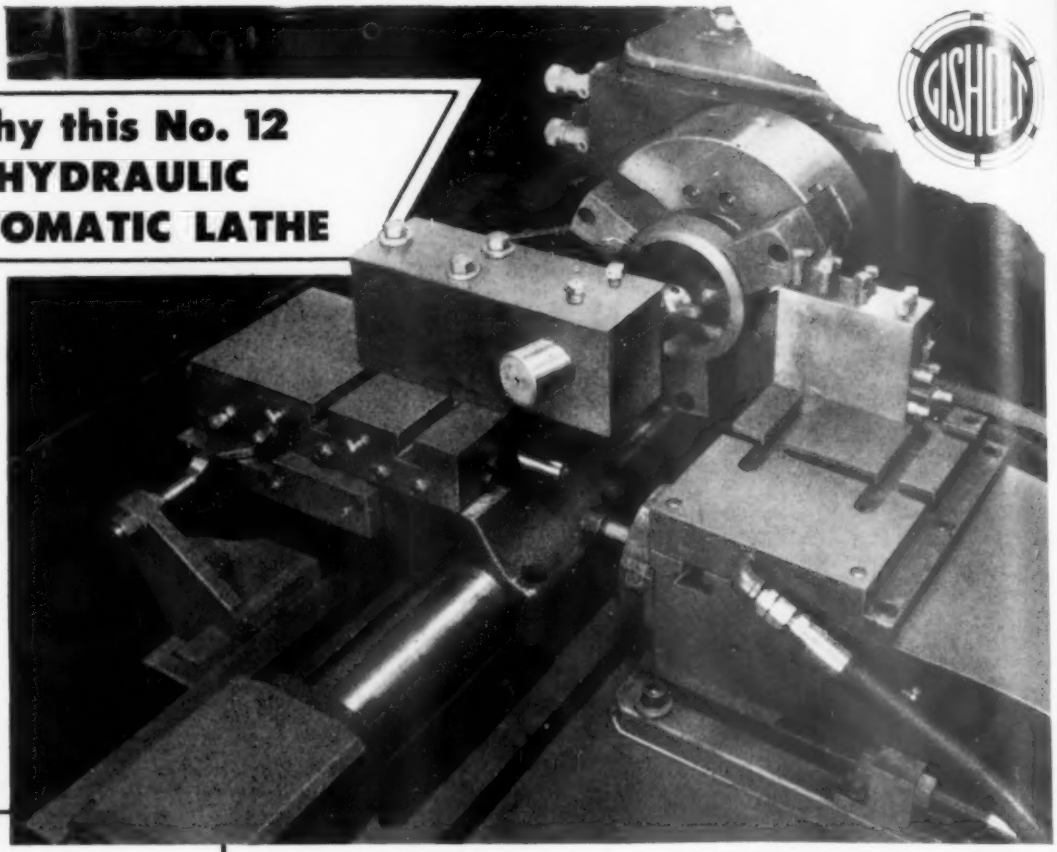
The secret in most cases is in the design of the tool. Avoided are: sharp corners, small projections from heavy sections, numerous holes with both thick and thin webs. If the tool can be designed to minimize such hazards, carbon tool steel is often an effective solution.

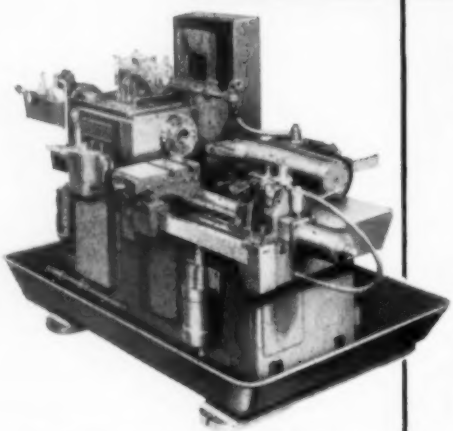
When there are many holes in a die made from carbon tool steel, a good heat-treater will carefully pack the holes with asbestos or fire clay, then heat carefully and uniformly to obtain a well-hardened die. This precaution reduces distortion during heat-treatment and avoids causing cracks in quenching.

HEAT AND TEMPER COLORS SHOWN ON HANDY CHART

Want to estimate the temperatures of heated steel? Our convenient color chart is printed in natural tones; heat colors are accurately reproduced on one side and temper colors on the other. Write for your free copy to Publications Dept., Room 1042, Bethlehem, Pa.

why this No. 12 HYDRAULIC AUTOMATIC LATHE





The Gisholt Hydraulic Automatic Lathe is a genuinely rugged 12" lathe, suited for light, fast jobs. Handles chucking, between centers, or fixture-held work.

maintains GREATER ACCURACY

Here, feed pressures are applied directly to tools without intermediate cams, arms or other linkage. Accuracy is further insured by feeding against dead stops. In all cuts there is a moment of dwell during which cuts are cleaned up.

Front carriage is mounted on and driven by the massive bar to which it is clamped. Wide lateral support of carriage assures rigid alignment without tremble or tremor.

Movement of the massive rear slide is by hydraulic piston in the base of the slide itself.

Both carriages are directly supported by the massive integrally cast cabinet type bed, and all bearing surfaces, ways and gibs are hardened and ground steel to assure permanent accuracy.

THE GISHOLT ROUND TABLE

represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

TURRET LATHES · AUTOMATIC LATHES · SUPERFINISHERS · BALANCERS · SPECIAL MACHINES

ASSEMBLE AND INSPECT UNDER MAGNIFICATION *in one operation...*

with the Kodak Contour Projector

This starter switch for a refrigerator motor presents a tough assembly and inspection problem. The springs must be accurately bent and adjusted by hand—tolerances are close.

With the Kodak Contour Projector the whole operation—bending and checking—may be done at the same time and under the magnification that's most convenient.

Since the Kodak Contour Projector has provisions for surface illumination from the same lens that picks up the image, every detail of the switch is shown on the screen. A 45° mirror permits the part to be mounted flat for easy accessibility. Both to adjust the part and check tolerances, the operator simply compares the magnified image with a chart-gage laid on the bright screen.

Whether your interest is in large parts or small parts, simple parts or complex parts with many dimensions, a Kodak Contour Projector will do the job quickly, completely, and accurately. The operator can work in a lighted room unhampered by hoods or curtains. And little training is required to get the work out in a hurry.

For rapid, routine inspection and adjustment work, the economical, stripped-down Kodak Contour Projector, Model 3, will meet your requirements. For toolroom measurement, the versatile Model 2A is what you need. In your area there is an experienced field engineer who will be glad to discuss your own particular problems. You can get in touch with him by writing Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Optical Gaging

A new sound movie shows how to simplify complex inspection problems. We'll tell you how to get it for a showing.

Kodak
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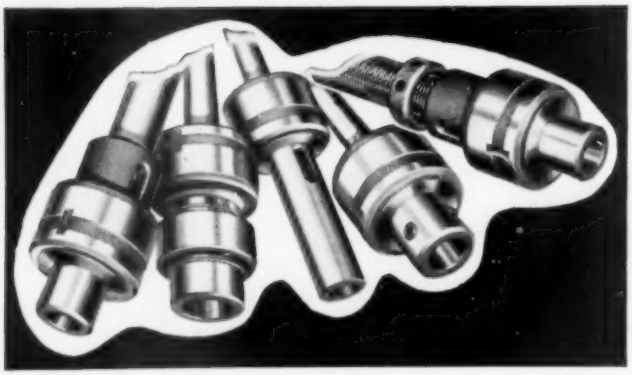

Need More
PRODUCTION?

Put your old worn machines to work! You'll get more production quick, even on close tolerance jobs, with your present machines—new or old—with

GLENCO
Floating Tool Holders

They automatically correct alignment as they operate—to 1/32" radius or 1/16" diameter — save time setting up fine adjustments.

You Don't Believe It?

Prove it on your own jobs without cost. Order a GLENCO Holder now—try it 30 days—then return it or pass for payment. You're the judge.

Capacities up to 5" tool diameters in stock. Above illustration shows 5 of the 26 styles. Only 11 parts, all interchangeable within each size range. All are hardened and ground to close tolerances so wear is negligible.

Send for Complete Data File J.

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Talide
(TUNGSTEN CARBIDE)
MEETS EVERY REQUIREMENT

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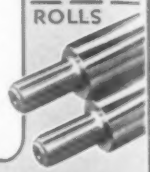
BAR STOCK

BLADES

TOOLS

ROLLS



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For the past twenty-five years actual operating records have proven the advantages of Talide tools, dies, blades, bushings, rolls and other tungsten carbide products.

On most cutting, drawing, rolling and wear-resistant applications, you can triple your production and cut costs in half. Extra long runs make Talide Metal less expensive than steel.

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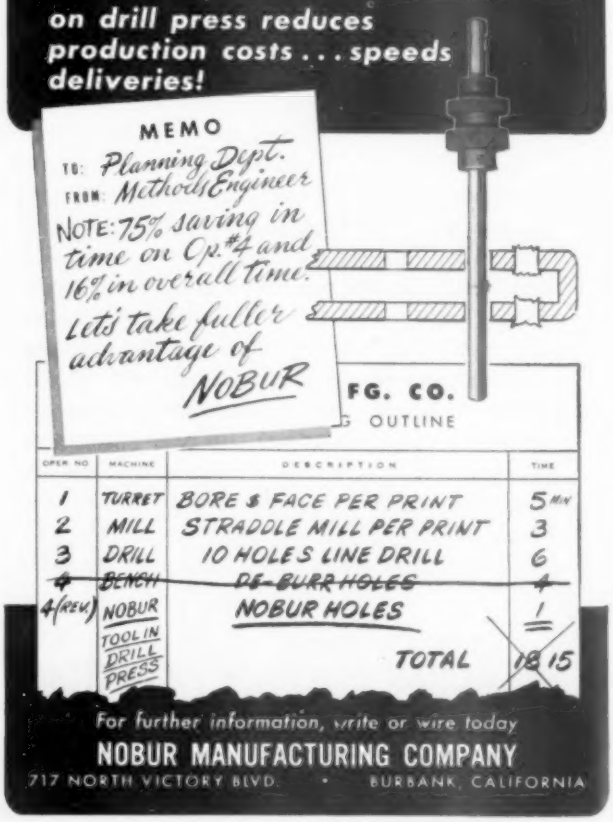
on drill press reduces production costs . . . speeds deliveries!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TO: Planning Dept.
FROM: Methods Engineer
NOTE: 75% saving in time on Op. #4 and 16% in overall time!
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1 | TURRET | BORE & FACE PER PRINT | 5 MIN
2 | MILL | STRADDLE MILL PER PRINT | 3
3 | DRILL | 10 HOLES LINE DRILL | 6
4 | BENCH | DE-BURR HOLES | 4
4 (NEW) | NOBUR TOOL IN DRILL PRESS | NOBUR HOLES | 1
TOTAL 18 15

For further information, write or wire today
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CLEEREMAN DRILLING MACHINES

LOWEST Operating Costs!

Why?

1—Eliminate Down Time.

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3—Lowest Maintenance Costs.

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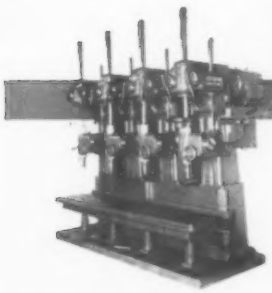
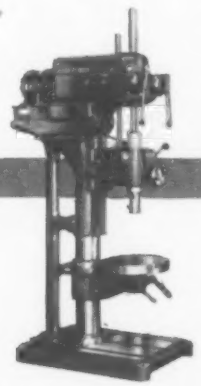
Go to any Cleereman user for proof.

Cleereman Box Column Drilling Machine.



Cleereman Multiple Drilling Machine.



Cleereman Round Column Drilling Machine.

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VERTICAL TURRET LATHES

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The rigid construction and ample range of speeds provide for maximum cutting efficiency with either carbide or high speed tools. Down time is minimized as all controls are centrally and conveniently located. Fine adjustments for cutting tools are so placed that operators can closely observe cutting edges—even on small workpieces.

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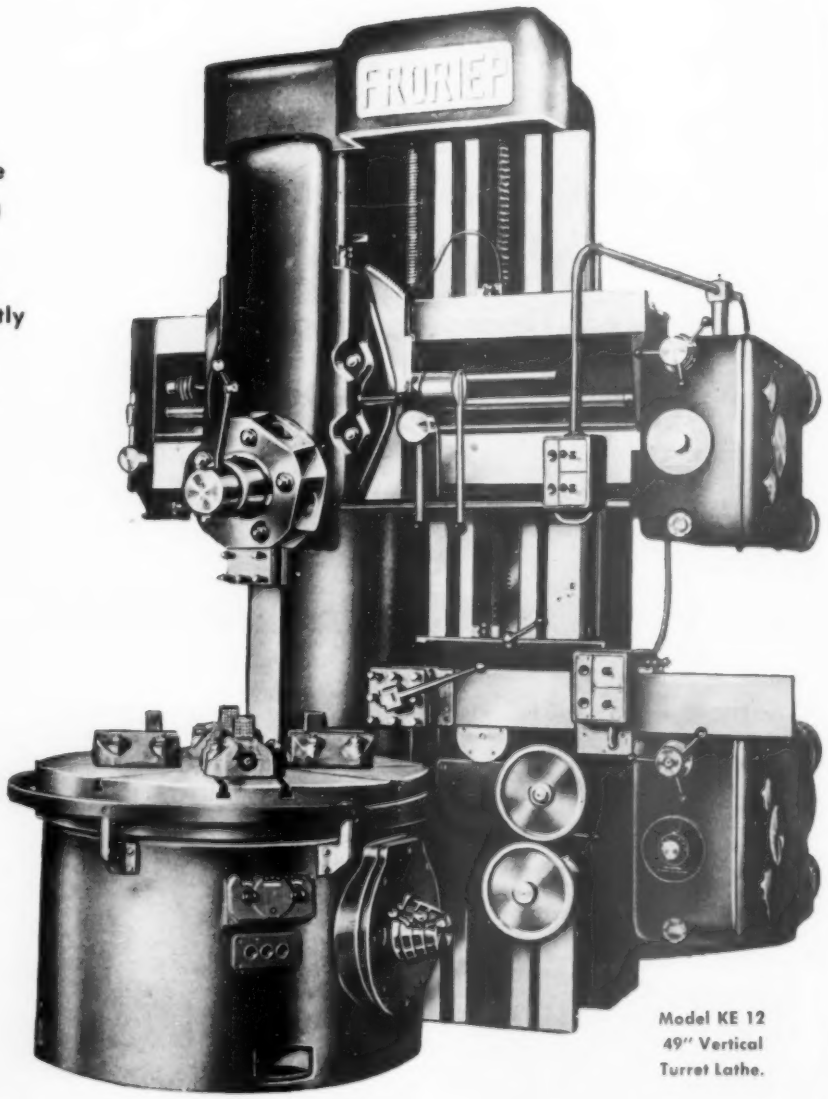
Write for catalog fully describing these Vertical Turret Lathes.



Model KE 12
49" Vertical
Turret Lathe.

COSA CORPORATION
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IN DETROIT AREA contact DETROIT-COSA CORPORATION, 16923 James Couzens Highway, Detroit 35, Mich.

Reverse brake band anchor forging

Finished work part

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the Key to Broaching Speed and Economy

Because the fixtures so often determine the speed and economy of broaching operations, it is just "good business" to entrust their design to specialists of proven experience and ability in the broaching field. Manufacturers, high production and job lot, depend on Red Ring broach engineers to develop their tooling.

Illustrated here are some of the fixtures used to produce the reverse brake band anchor, an element of a modern automotive torque converter. Of the 7 machining operations on this part, 5 are broaching.

Ask Red Ring broach engineers for suggestions on your tooling.

NATIONAL BROACH & MACHINE CO.

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Made in 12 sizes in all degrees; also supplied as sets in strong Kit-cases.

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"INDEX TO PROFITS" . . . Follow the assembly of an intricate 34-piece automobile door latch through a highly compact, production line that saves space and cuts lost motion to the minimum. (20 minutes running time.)
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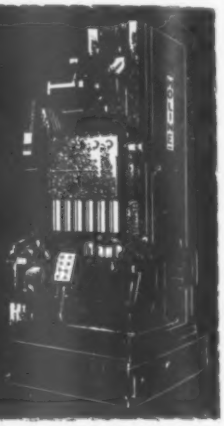
MOLINE "Hole-Hog"
SPECIALLY DESIGNED
MACHINE TOOLS
HAVE CUT PRODUCTION COSTS FOR AMERICAN INDUSTRY



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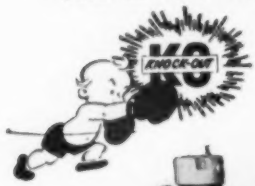
of all popularly-priced Tool and Cutter Grinders sold in 1951 were *"Knock-Outs"*



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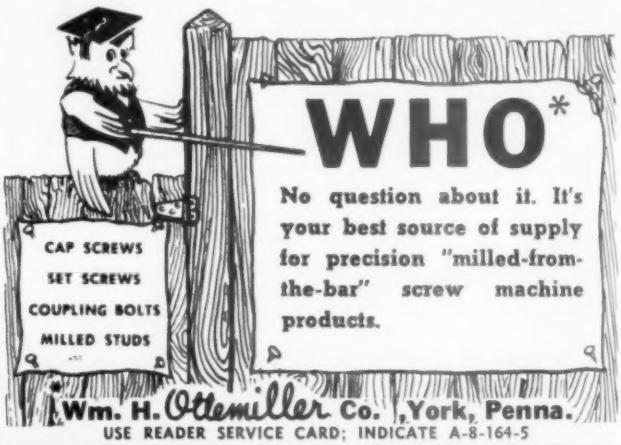

WHO*

No question about it. It's your best source of supply for precision "milled-from-the-bar" screw machine products.

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The "214" automatically feeds, inserts and clinches two rivets at a time...with speed that may mean a big saving in your fastening costs.

14" throat makes large assemblies easy to handle. For tubular rivets as large as 9/64", or less in length. Quick Change Rotary Type Hoppers and Raceways permit a 5-minute changeover to rivets of different size. Adjustable anvils and riveting centers add to its versatility.

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FREE CATALOG contains valuable engineering information and rivet specifications plus illustrated descriptions of 26 Chicago Automatic Rivet Setters.

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Branch Factory: Tyrone, Pa.

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Mississippi Pilots Use Marking Devices

Samuel Clemens adopted his pen name from the expression used by Mississippi River Pilots, such as he, indicating the 2 Fathom Marking Device affixed to their lead lines.

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Whatever your requirements, from small Hand Stamps to Pneumatic, Hydraulic or especially created Marking Machinery, CADILLAC STAMP COMPANY stands ready to supply or design and build to meet your needs.

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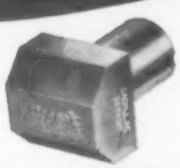
Compact, self-contained, manifold mounted. One control gives full range of marking depth. It will mark round, flat and irregular surfaces. Machine capacity is up to 110 one inch impressions per minute.

SOLID ROLL DIE
Assuring the utmost in accuracy—used in marking machines, lathes and screw machines.



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Faithfully reproduces and is particularly adapted to large production marking.

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Depending on requirements, can be had for either solid or interchangeable type.

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Kling can save you time and money on STRUCTURAL SHAPES like these

Do you use curved reinforcements? Then Kling Engineers can show you how to reduce material, machining and assembly costs with Kling Structural Shapes engineered to your requirements. These rolled shapes replace expensive and obsolete casting and plate cutting methods. Only a few shown here; variety is almost unlimited. No job too large or too small.

Send us prints and specifications of your job for suggestions, with no obligation to you. Kling Bros. Engineering Works, 1321 N. Kostner Avenue, Chicago 51, Ill.

Just a few examples of how these structural shapes are being used:

- Smoke Stack Reinforcements
- Store Fronts
- Curved Racks (for Pinions)
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- Bull Wheels and Pulleys
- Furnace Reinforcements
- Guard Rails for Water Tanks and many other jobs and products

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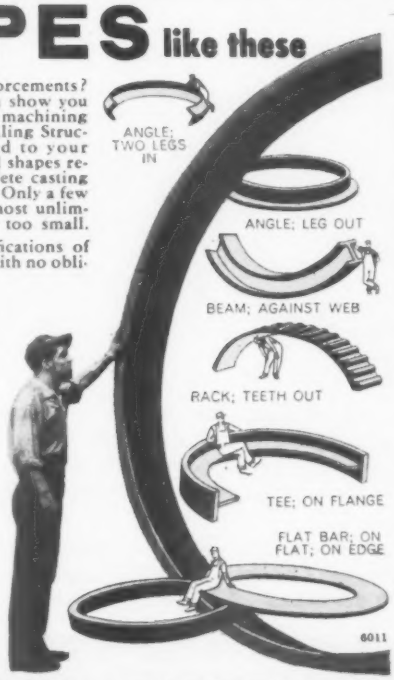

50 Years of Kling ...an investment in speed!

MANUFACTURERS OF: Combination Shear, Punch & Copers • Double Angle Shears • Rotary Shears • Punches • Plate Bending Rolls

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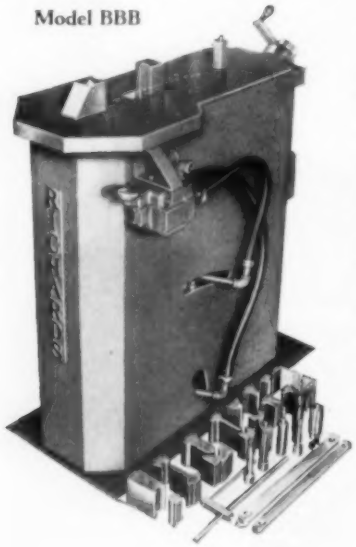
MULTIFORM BIG BROTHER BENDER

Produces Without Special Tooling—Saves Die Costs Saves on Expensive Presses

Model BBB



Illustrated above are a few of the many forms that can be produced efficiently on the Multiform Bender, using the standard tooling.

The heavy duty Big Brother Bender is designed for fabricating bus bars, brackets, fixtures, etc., without special tooling. Air controlled with finger tip response. Comes complete with dies, mandrels and wrenches—punching and blanking dies extra. Will punch holes up to 1" and form material up to ¼" thick by 4" wide. We also build smaller hand or air operated models for forming up to ⅜"x1½" material.

Send for illustrated folder TE-5

J. A. RICHARDS CO. 903 North Pitcher St. Kalamazoo, Michigan

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MEANS ROUSSELLE PUNCH PRESSES

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BLACK GRANITE SURFACE PLATES

Present an absolute continuous bearing surface, finished up to 50 millionths inch. Incredibly smooth. Falling objects do not cause humps. Being harder than hardened steel, can take greatest mistreatment without causing inaccuracy of surface. No oiling. Will not rust or warp. No re-scraping or frequent refinishing. Can use for spotting and "blueing in."

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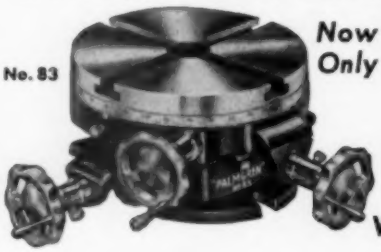
DUAL CROSS and ROTARY FEED

PALMGREN

Rotary, Index, Milling Table



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Now Only $54.50

Turns Your DRILL PRESS Into A VERTICAL MILLER

Think what this will mean in your shop! Can be used on any Drill Press, Lathe or Milling Machine and provides what is practically a universal milling machine.

Designed for use in all types of metal and woodworking shops. A precision table permitting fine work to close tolerances. It is accurate, speedy, well constructed and attaches quickly in a firm position.

Rotary feed calibrated in degrees; Cross feed in thousandths; Dual Cross Slide with cross feed 2½" each side of center or 4¼" overall. Has acme thread cross feed screws, adjustable gibs on cross slides. 40 to 1 worm and gear ratio in rotary feed. Equipped with bolt slots and locking screws.

No. 83 Table Dia. 8", T-Slots ⅜", Base Keyway ⅜", Base Dia. 6¼", Ht. 5", Wt. 37 lbs. Price Only $54.50. Other Types available. No. 82 Dual Cross Feed only $43.75; No. 86 Rotary Feed Only $46.75.

Order Today! If dealer can't supply, write us. Ask for Circular No. 10

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There's a Walker Magnetic Chuck for Every Known Application . . .

For sixty years, Walker has specialized in the designing and production of magnetic holding devices. Today, Walker produces a complete line of magnetic chucks and designs special chucks to meet unusual holding problems.

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Standard Electro and Permanent Magnetic Chucks . . . Vacuum Chucks . . . Special Applications for various holding problems . . . Demagnetizers . . . Magnetic clutches.

Original Designers and Builders of Magnetic Chucks

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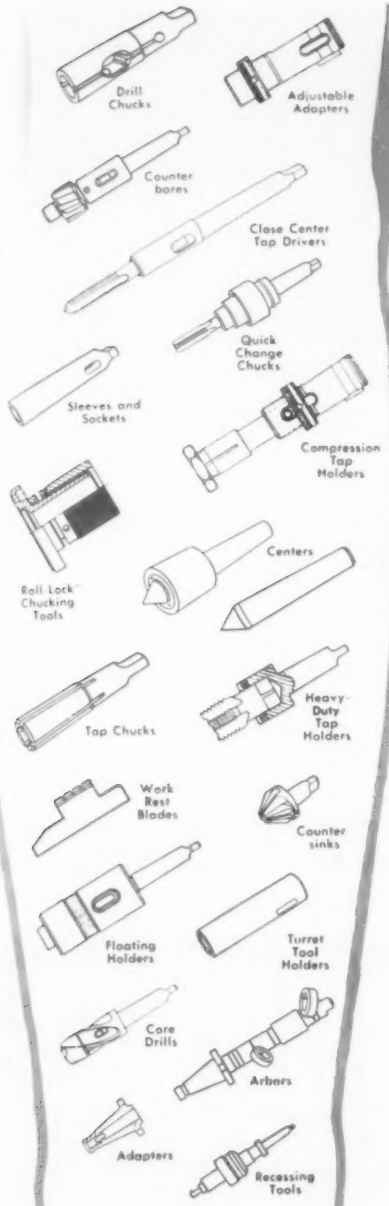

NEW DRILL STOP

...a positive control for depth of hole

by SJ SCULLY JONES

End Guesswork and Reduce Rejects:
You often require close control of depth for operations — as in center drilling, drilling and reaming — on turret lathes, radial drills and other machines. On these operations, or wherever a quick change arrangement is used in one station for sequence operations, you hold uniform hole depth by using the new S-J Drill Stops. They provide a positive stop which ends guesswork and reduces rejects.

Quick and Easy to Insert, Remove and Adjust Tools:
Simply loosen set screw and slip stop collar from threaded shank for quick insertion or removal of taper shank tools. The threaded lock bushing provides quick and accurate adjustment of the stop collar. Only a quarter turn of the set screw forces the bushing against the shank threads for a positive lock.

Work on Close Centers:
The small body diameter permits you to operate these Drill Stops on close centers and near shoulders or other obstructions.

Trouble-Free Performance:
S-J Drill Stops are made from an alloy steel with all points of wear hardened for long life. The four chip grooves tend to break up and remove any chips from the surface on which it stops. Investigate the use of S-J Drill Stops wherever you require a positive control for depth of hole. Made in 8 sizes having Morse Taper shanks and holes.

Write for BULLETIN NO. 18-50 for data on Drill Stops.

Scully-Jones AND COMPANY

1915 S. Rockwell St., Chicago 8, Ill.

R3172

YOU GET LOW COST FAST ACCURATE PRODUCTION WITH OUR STANDARD AND SPECIAL TOOLS

the "ARMS and HANDS" for your MACHINE TOOLS

If you think of a Lathe, Mill, Multi-Spindle Machine, or other Machine Tools as being a human body, supplying power to the parts of the body doing the actual work, then Scully-Jones tools represent the "Arms and Hands".

A YEAR-ROUND "TOOL SHOW"

You can see the S-J Standard Tools (sketched in the column at the left) on display or in operation the year-round, at the Scully-Jones plant. For year-round reference too, you'll find complete information on these and other tools, in the S-J Catalog 600—yours on request, on your company letterhead.

These "arms and hands" — as we like to call them — will help you equip your machine tools for low cost, fast, accurate production.

Whether you select Scully-Jones Standard or Special Tools you can be confident of getting the best that can be produced — the result of 40 years' experience, engineering research, modern equipment, correct materials and expert workmanship. Recently Scully-Jones manufacturing facilities have been further expanded to give you more reasonable deliveries.

Whenever your tooling problems or design programs require outside service, S-J Engineering and Design Service has "heads and hands" to help you. Whether large or small, let us discuss your engineering problems and design programs.

For quick action see the nearest Scully-Jones representative or contact us direct.

HOW IS YOUR METAL-WASHING MACHINE WORKING?
DO THE NOZZLES CLOG TOO OFTEN?
IS THERE TOO MUCH FOAMING?
EVERYTHING IS O.K! WE ARE GETTING OAKITE SERVICE

Is your washing machine removing buffing compounds as thoroughly as it removes cutting oil and metal chips?

Is it cleaning brass, aluminum and zinc die castings as well as it cleans steel?

Oakite chemists and service engineers have developed cleaning materials that meet every requirement for washing metal by machine. Oakite Technical Service Representatives know how to make these materials work at top efficiency in all types of machines.

Years of Oakite experience are compressed into a 16-page booklet called "*8 things to look for when you wash metal by machine*". You'll want to read the notes on:

- ¶ How to select the best detergent for each job. *See pages 4 to 6.*
- ¶ When to use a solvent detergent. *See page 7.*
- ¶ When to use an alkaline detergent. *See page 8.*
- ¶ How to prepare metal for painting. *See page 9.*
- ¶ Tips on selection and operation of washing machines. *See pages 10 to 12.*
- ¶ Special instrument aids to better operation. *See page 13.*

FREE For a copy of "*8 things to look for when you wash metal by machine*," write to Oakite Products, Inc., 58 Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

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MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada

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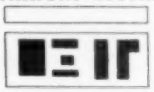
WORKING SHEET OR PLATE STEEL?

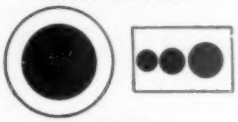
LOOK at what PULLMAX CAN DO

STRAIGHT CUTTING



Straight cutting, circle cutting, free hand cutting, slot cutting, beading, folding, louvering and many variations of these operations . . . ALL ON ONE PULLMAX MACHINE! Easy to set up and change tools . . . seven sizes of machines work materials up to 11/32" in mild steel . . . also works stainless steels, non-ferrous metals, wire mesh and plastics.

CIRCLE CUTTING



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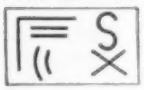
FOLDING

SLOT CUTTING



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PULLMAX—A complete sheet and plate working shop in one machine.

AMERICAN PULLMAX CO., INC.

2451 N. SHEFFIELD AVENUE CHICAGO 14, ILLINOIS

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Valve Stem for Fuel Injection System, Jet Propulsion Engine. MATERIAL Stainless Steel

Ball and Race Unit for Radar Instrument. Lapped to No. 3 Micro Finish .0001 Accuracy all over. MATERIAL: Nitralloy

.. ARE PRECISION-MADE by...

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Close tolerance parts for aircraft, radar, electronics, precision instruments, etc. Screw machine, milling, boring, grinding, honing, and lapping operations, with accuracies to .00005. Fine finishes to No. 3 Micro. Heat resistant and stainless steel, Nitralloy, bronze, etc.

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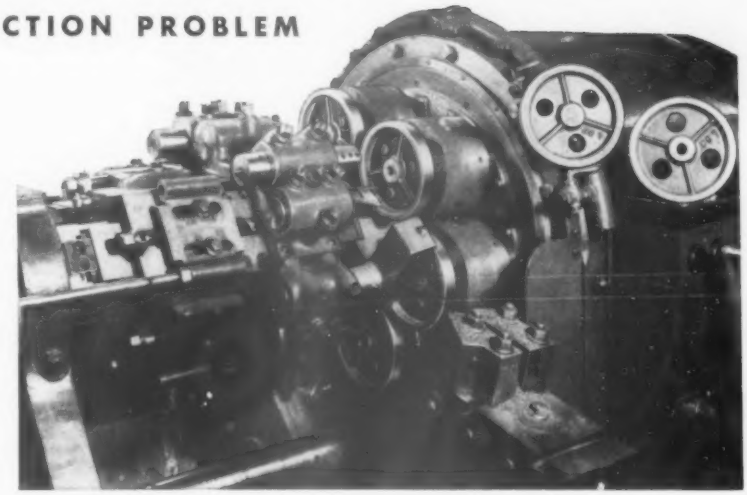
HIGH PRODUCTION TOOLING

TYPICAL OF THE EXTRA VALUES YOU GET WHEN YOU BRING A PRODUCTION PROBLEM TO BAIRD . . .



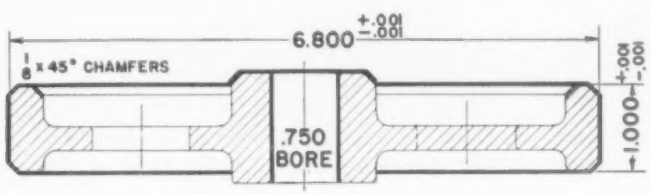
BAIRD No. 76H AUTOMATIC CHUCKING MACHINE

Year-in and year-out, in many automobile and other headlined production plants, Baird's No. 76-H Automatic Chucking Machine has proved itself to be one of the best production units of its kind. It's easy to operate and service; has unusual versatility in tooling, operations, speeds; and it cuts costs with quality control.

But the pay-off comes when Baird engineers adapt this 6-spindle unit to your specific tooling and production requirements.

For example, gear blanks (drawing below) are turned completely in one operation as shown. Material: High tension iron-hardness 85-90 Rockwell B scale. Production: 65 seconds each, 55 pieces per hour.

Of course we're busy. But not too busy to try and solve a problem for a new or old customer. Ask Baird about it!



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AUTOMATIC MACHINE TOOLS • AUTOMATIC WIRE & RIBBON METAL FORMING MACHINES • AUTOMATIC PRESSES • TUMBLING BARRELS

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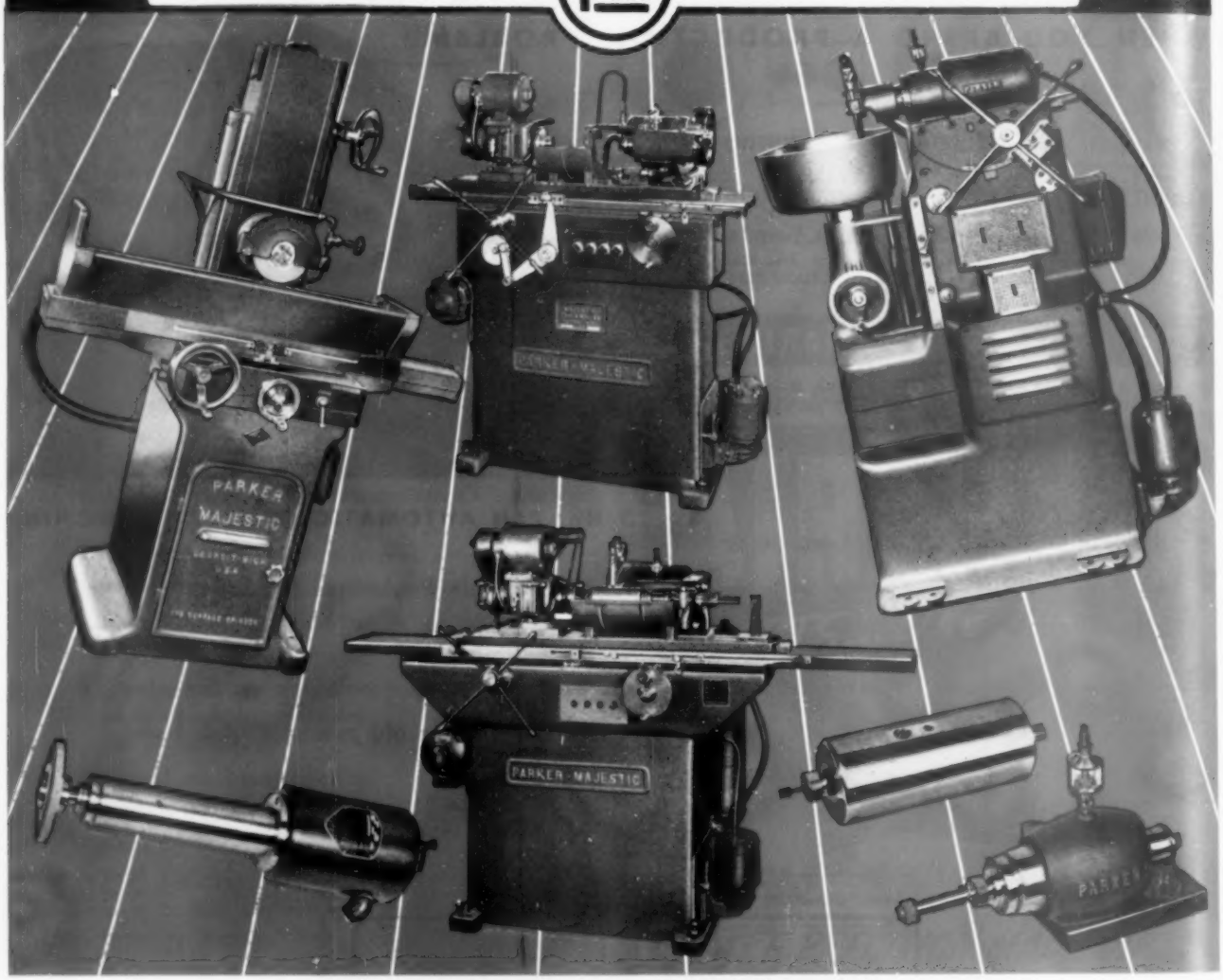
PARKER • MAJESTIC pm **PRECISION MACHINES**



Above is pictured the home and products of the

PARKER-MAJESTIC, INC.

For almost a quarter of a century this company has manufactured the Parker Spindles used in Precision Grinding, Boring and Milling applications. Additional products include the well known line of Parker-Majestic Internal, External, No. 2 Surface and Rotary Surface Grinders.

Descriptive literature upon request.

PARKER-MAJESTIC, INC.

formerly **MAJESTIC TOOL & MFG. CO.**

147 JOS. CAMPAU • DETROIT 7, MICHIGAN

"no more GAMBLING on tool steel selection"

[⅓ actual size; Selector is in 3 colors]

That's what one of the thousands of pleased users says about his CRUCIBLE TOOL STEEL SELECTOR, the new, simple, handy method of picking the right steel, *right* from the start. Since Crucible announced this Selector two years ago, thousands of tool steel users have received their Selectors . . . and here's what some of them say—

"Handiest selector I've ever seen!"
"Saves me time and headaches"
"It's so logical—you begin with the application".

You can be sure the answer you get with your Crucible Tool Steel Selector will be just right in every case, for this Selector covers 22 tool steels which fit 98% of all tool steel applications. And when—with a flip of the round dial—you get the answer, you'll get the steel FAST, too, because all the tool steels on the Selector are right in stock, in all our 26 conveniently-located warehouses.

This Selector is bound to be a big help to you—so write for yours today. There is no obligation whatsoever. Just fill in the coupon and mail now . . . before you turn this page and forget! CRUCIBLE STEEL COMPANY OF AMERICA, Chrysler Building, New York 17, New York.

Here's how it works:

To use the Selector, all you need know is the characteristics that come with the job: type and condition of material to be worked, the number of pieces to be produced, the method of working, and the condition of the equipment to be used.

FOUR STEPS—and you've got the right answer!

1. Move arrow to major class covering application
2. Select sub-group which best fits application
3. Note major tool characteristics (under arrow) and other characteristics in cut-outs for each grade in sub-group
4. Select tool steel indicated

That's all there is to it!

Here's an example:

Application—Deep drawing die for steel

Major Class—Metal Forming—Cold

Sub-Group—Special Purpose

Tool Characteristics—Wear Resistance

Tool Steel—Airdi 150

One turn of the dial does it!

And you're sure you're right!

Crucible Steel Company of America
Dept. T, Chrysler Building, 405 Lexington Avenue
New York 17, N. Y.
Gentlemen:
Sure! I want my free CRUCIBLE TOOL STEEL SELECTOR!
Name_____ Title_____
Company_____
Street_____
City_____ State_____

CRUCIBLE first name in special purpose steels

TOOL STEELS

52 years of Fine steelmaking

Branch Offices and Warehouses: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DENVER • DETROIT HOUSTON, TEXAS • INDIANAPOLIS • LOS ANGELES • MILWAUKEE • NEWARK • NEW HAVEN • NEW YORK • PHILADELPHIA • PITTSBURGH • PROVIDENCE ROCKFORD • SAN FRANCISCO • SEATTLE • SPRINGFIELD, MASS. • ST. LOUIS • SYRACUSE • TORONTO, ONT. • WASHINGTON, D. C.

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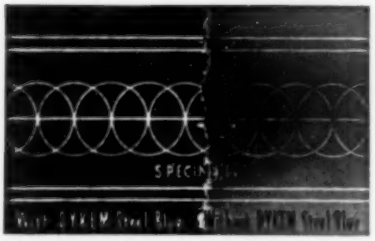
DYKEM STEEL BLUE

ST OPS LOSSES

making dies & templates



Simply brush on right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed layout show up in sharp relief and at the same time prevents metal glare. Increases efficiency and accuracy.

Write for full information

THE DYKEM COMPANY, 2303D North 11th St., St. Louis 6, Mo.

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FELLOWS

FOR CUTTING
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in **GEAR PRODUCTION**

THE FELLOWS GEAR SHAPER COMPANY, SPRINGFIELD, VERMONT

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Outstanding FOR TAPPING AND REAMING

Reduces Spoilage Losses

When tapping and reaming jobs come through with oversize or bell-mouthed holes, it is a simple matter to correct the difficulty. Change over to a Ziegler Floating Holder which automatically compensates for inaccuracies in set-up, even though they amount to as much as 1/32" radius or 1/16" diameter.

Take a few minutes to figure up what your rejects are costing you each month and you will appreciate the economy of equipping your machines with Ziegler Holders.

The reduction in spoilage losses, you'll find, will pay for a Ziegler Holder many times over in the course of a year. Try it and see!

W. M. ZIEGLER TOOL COMPANY

13574 Auburn Detroit 23, Mich.

WRITE FOR CATALOG

Ziegler ROLLER DRIVE **FLOATING HOLDER** for Taps and Reamers...

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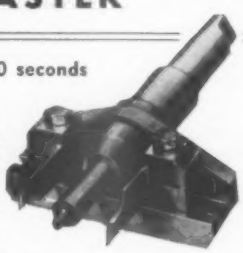
Cut Costs on Hole-Cutting with BOREMASTER

5" Holes in 1" steel plate in 80 seconds
Precision within .004"



Finished holes 1½" to 11¾" diameter to a depth 8" in one rapid operation on your present equipment with the BOREMASTER. Comparable boring tool finish.

Not just another trepanning cutter but a real heavy duty tool. Stock removed in one piece, eliminating waste.

Time Savings + Material Savings = Cost Savings

For details, write:

KARL A. NEISE, 381 4th Ave., Dept. A, New York 16, N. Y.

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Process Engineers
Tool Designers
Operation Sheet Writers
Tool Trouble Men

FAIRCHILD
ENGINE DIVISION
OF THE
FAIRCHILD ENGINE & AIRPLANE CORP.
New Highway, Farmingdale,
Long Island, New York

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"How We Boosted Production With A Special Machine Built Around DELTA DRILL UNITS"

DIFFICULT STAINLESS STEEL DRILLING OPERATIONS PERFORMED SEMI-AUTOMATICALLY

Says J. A. LOGAN, Chief Production Engineer, Solar Aircraft Co., San Diego, California

"With machine tools hard to get, and skilled manpower in dwindling supply, we are always on the alert to develop unitized tools that perform multiple operations semi-automatically and with minimum attention. One recent problem was solved by Delta Air Powered Hydraulic Drill Units.

"This unitized tool bores exhaust cones for jet engines. Two Delta Drill Units are set 90° apart, pointed to the rotary table which is full indexing. With push-button operation, cycling is automatic. Two holes are drilled at once."

"Results were important—

- **sharply increased production**
- **release of a radial drill press for other duty**
- **set-up time, a serious item with the drill press owing to the shape of the cone, practically eliminated."**

ONLY THE DELTA AIR POWERED HYDRAULIC DRILL UNIT HAS ALL THESE FEATURES:

Hydraulic Feed . . . quickly adjusted, infinitely variable—no recamming or changing lead screws to alter feed.

Rapid Traverse . . . positive stop, quick, accurate control—no over-travel; reduces tool breakage. Approach consistently at 5 to 6 inches per second to within .010 inch of work.

Depth Control . . . positive stop, quick, accurate—no over-travel; repeats depth consistently to within .0005 inch.

Universal Mounting . . . units can mount in any position.

Automatic Cycling . . . built-in cycle control switches provide for full electrical remote control. Eliminates installing external switches. Drilling units positively electrically interlocked with automatic indexing table.

Special Spindles . . . drive arrangements and other features are available at slight additional cost, including new two-way valve to permit spindle to function with normal rapid retraction or to back feed, as desired

Three Sizes—capacities up to 5/16-inch diameter drill, 1½-inch stroke; ½-inch diameter drill, 4-inch stroke; and 1-inch diameter drill, 6-inch stroke.

Another Rockwell Product

There's a Delta Power Tool for Your Job-

WOOD OR METAL WORKING

53 MACHINES • 246 MODELS • MORE THAN 1300 ACCESSORIES

DELTA MILWAUKEE

DELTA POWER TOOL DIVISION

Rockwell MANUFACTURING COMPANY

620H N. LEXINGTON AVENUE • PITTSBURGH 8, PA.

☐ Please send the name of the nearest Delta Drill Unit Authorized Representative.

☐ Please send me new Drill Unit Catalog.

Name_____

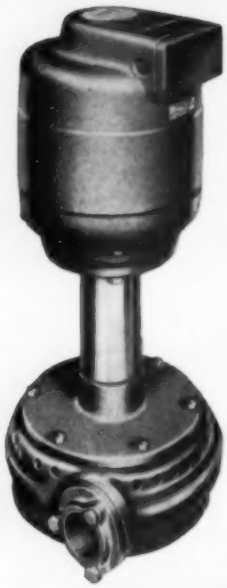
Position_____

Company_____

Address_____

City_____ Zone____ State_____

designed for TODAY and TOMORROW



RUTHMAN GUSHER
COOLANT PUMPS

Pioneers in the development of a practical machine-tool coolant pump, Ruthman has consistently offered you a better pump for your machines.

Totally enclosed drip - proof motors . . . heavy-duty prelubricated ball-bearings . . . electronically balanced rotating assembly, are a few of the many innovations Ruthman has introduced over the years. For the best coolant pump specify Ruthman. Write for catalog today.

THE RUTHMAN MACHINERY CO.

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Power-Torque Tools
Automatically CONTROL TORQUE IN MOTION

• Eliminate hand torquing inspection
• Speed-up production
• Reduce Scrap
• Easily torque-test pre-loaded bearings
• Conserve skilled labor

• New Power-Torque Tools offer higher capacities . . . 0 to 2760 inch-lbs. Custom models in any desired torque range. All *measure torque in motion* at time of driving studs, nuts, screws to within 2% of pre-set torque limits. Write for complete illustrated specifications on Power-Torque Tools, Garvin Brothers, Inc., P.O. Box 536, South Bend, Ind., Dept. E-8

POWER-TORQUE TOOLS
manufactured only by
GARVIN BROTHERS, INC.

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are you still running nuts one-at-a-time?

Ingersoll-Rand Multiple Nut Runners have increased output 70% over single power wrenches.*

For years multiple drilling, tapping and reaming have saved time and dollars. . . . Now you can tool for increased savings with Ingersoll-Rand *Multiple Nut Runners.*

MULTIPLE NUT RUNNERS GIVE YOU:

- 2 or more nuts driven at once . . . in the time formerly required to drive one.
- Good "quality control." . . . Torque is uniform on each and every nut.
- Safe Operation for operator. . . . Torque reaction is non-existent.
- Immediate on-the-job operation. . . . No special training needed for the operator.
- Low Maintenance. . . . Units in service show maintenance savings up to 50%.

All Ingersoll-Rand Multiple Nut Runners are built to your specifications. Our power-tool application engineers will gladly go over your nut running jobs with you and make their recommendations—there's no obligation on your part. Send for Bulletin 5099.

***Here's Nut Running History in the making!**

The times below from the records of a leading car manufacturer are based upon 1000 units of comparable nut running operations.

1912	Hand Wrench	200 Man Hrs.
1917	Speeder Wrench	100 Man Hrs.
1928	Single Power Wrench	50 Man Hrs.
1952	Multiple Nut Runner	14 Man Hrs.

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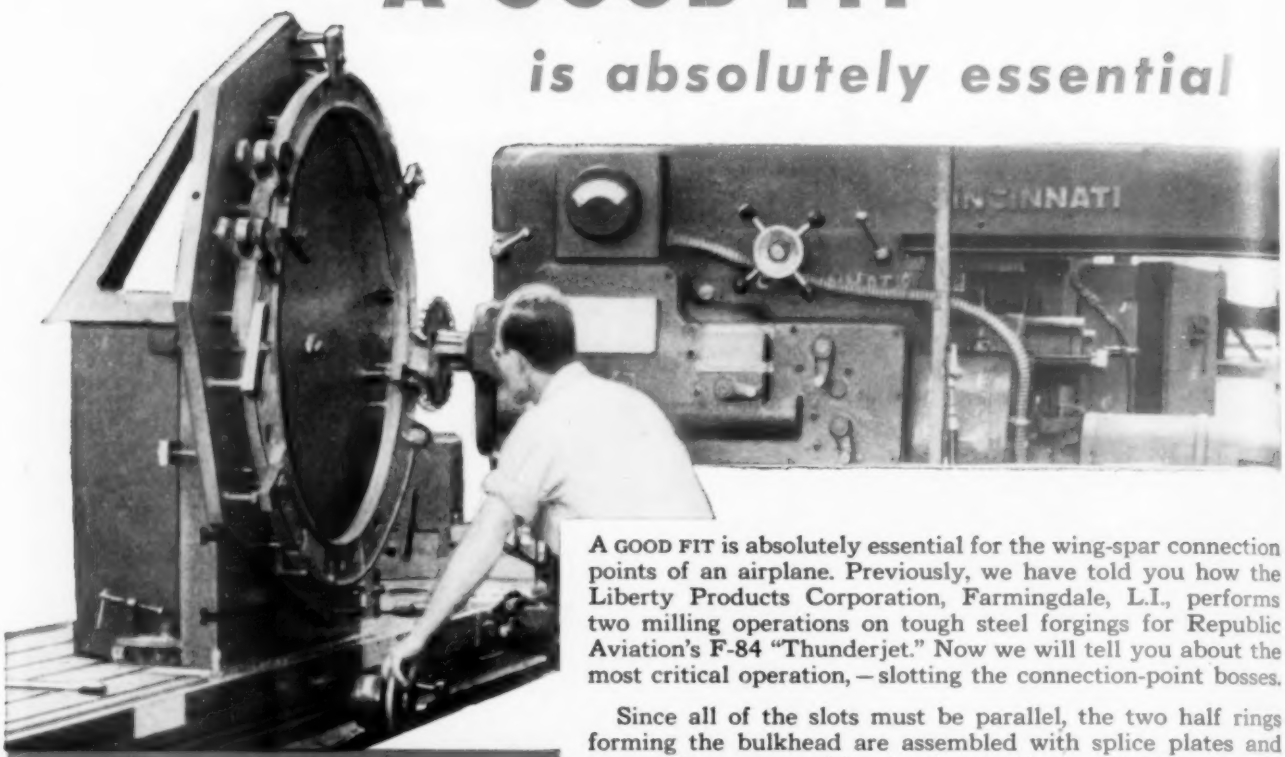
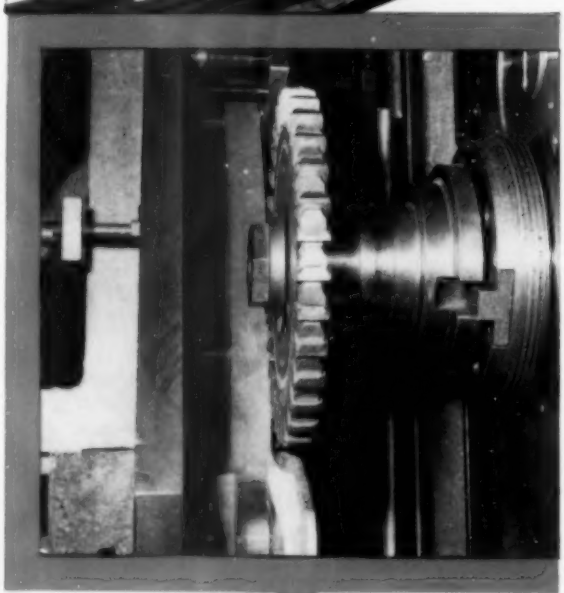
OK Carbide Cutters mill vital "Thunderjet" forgings — III

A GOOD FIT

is absolutely essential





A GOOD FIT is absolutely essential for the wing-spar connection points of an airplane. Previously, we have told you how the Liberty Products Corporation, Farmingdale, L.I., performs two milling operations on tough steel forgings for Republic Aviation's F-84 "Thunderjet." Now we will tell you about the most critical operation, — slotting the connection-point bosses.

Since all of the slots must be parallel, the two half rings forming the bulkhead are assembled with splice plates and mounted on a box table placed on a Cincinnati 36-in. Hydro-Tel milling machine. The 8 slots in an assembled ring are milled with an OK 12-in biaxial slotting cutter to these tolerances: width, plus 0.002 in., minus nothing; depth, plus 0.010 in., minus nothing. One assembly is slotted per hour, and three pieces are produced per cutter grind. Spindle speed is 35 rpm and the feed rate is 2.5 in. per min.

It is not a happenstance that OK cutters are used for all three operations on this critical aircraft bulkhead. Liberty Products Corp. has standardized on OK cutters and uses them for a multitude of operations on more than 50 milling machines.

The inserted-blade principle developed and perfected by the OK Tool Company produces economical milling in plants making all kinds of products — airplane components, machine tools, printing presses and run-of-the-mine articles in all materials. Good performance starts with a heat-treated alloy steel body that easily absorbs the stresses of modern milling on high-powered machines. Blade slots are accurately located and machined, so that the tool is always in "geometric balance." Hence, each of the inserted blades is presented to the work at precisely the proper angle and all blades take chips of equal thickness. And because the wedge-shaped blades require no locking devices, they cannot come loose to spoil cutter work, but they are easily removed for replacement.

OK cutters are made in a complete range of sizes and styles. Blades are offered in high-speed steel, cast-alloy or cemented carbide. Cutter bodies are available with slots to position blades for positive or negative rakes, straight or shear cuts. And blades are interchangeable for several sizes of a specific style of cutter.

Further reasons on why it pays to standardize on OK cutters are found in Catalog 13. Write for your copy.

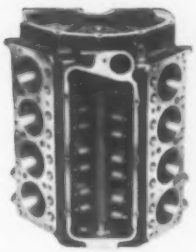
OK

modern milling cutters for modern milling machines

THE OK TOOL COMPANY, INC.
Milford New Hampshire

Performs 180 operations in 43.5 seconds. Drills, spot-drills, rough-bores, c'bores, c'sinks, and reams. Includes 360° rotating fixture for removal of chips at station No. 11, and automatic gauge of drilled holes at station No. 17.

UNIT No. 1



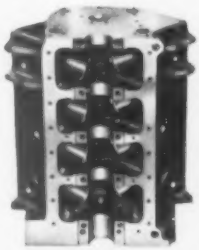
Capacity...

80!

CYLINDER BLOCKS AN HOUR

379!

OPERATIONS



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When you see these big Greenlee transfer machines working — turning out a tremendous quantity of work so smoothly and easily — you realize the qualities that make them great. Here is power, precision, durability, and a vast multiplicity of operations in a compact, integrated production line. Here is modern mass-production for component parts in its most successful form.

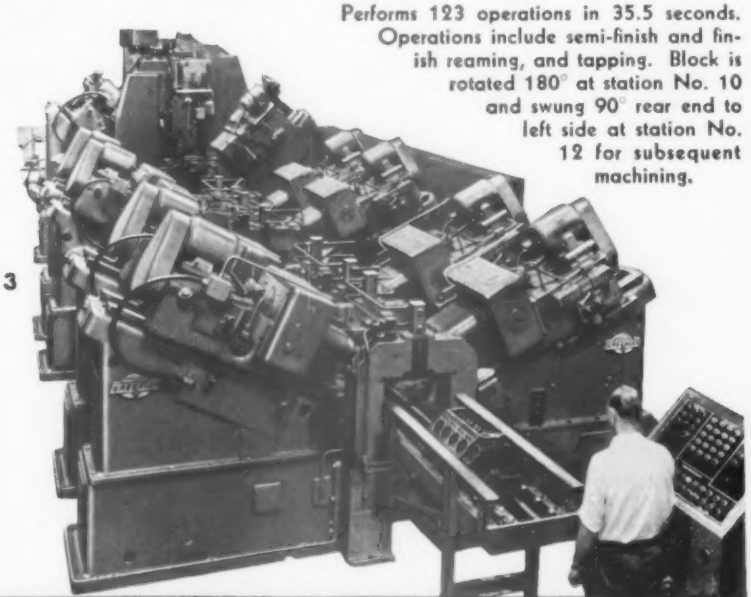
Concrete evidence of our experience and capability in designing and building Transfer Machines is exemplified with installations like this three-unit production line, now at work for a leading automotive concern.

UNIT No. 2

Performs 76 operations in 43.8 seconds. Drills, c'sinks, c'bores, and trepans. Tilts part at station No. 1 to 180° for subsequent machining. Automatically gauges and cleans drilled holes at station No. 20.

Performs 123 operations in 35.5 seconds. Operations include semi-finish and finish reaming, and tapping. Block is rotated 180° at station No. 10 and swung 90° rear end to left side at station No. 12 for subsequent machining.

UNIT No. 3



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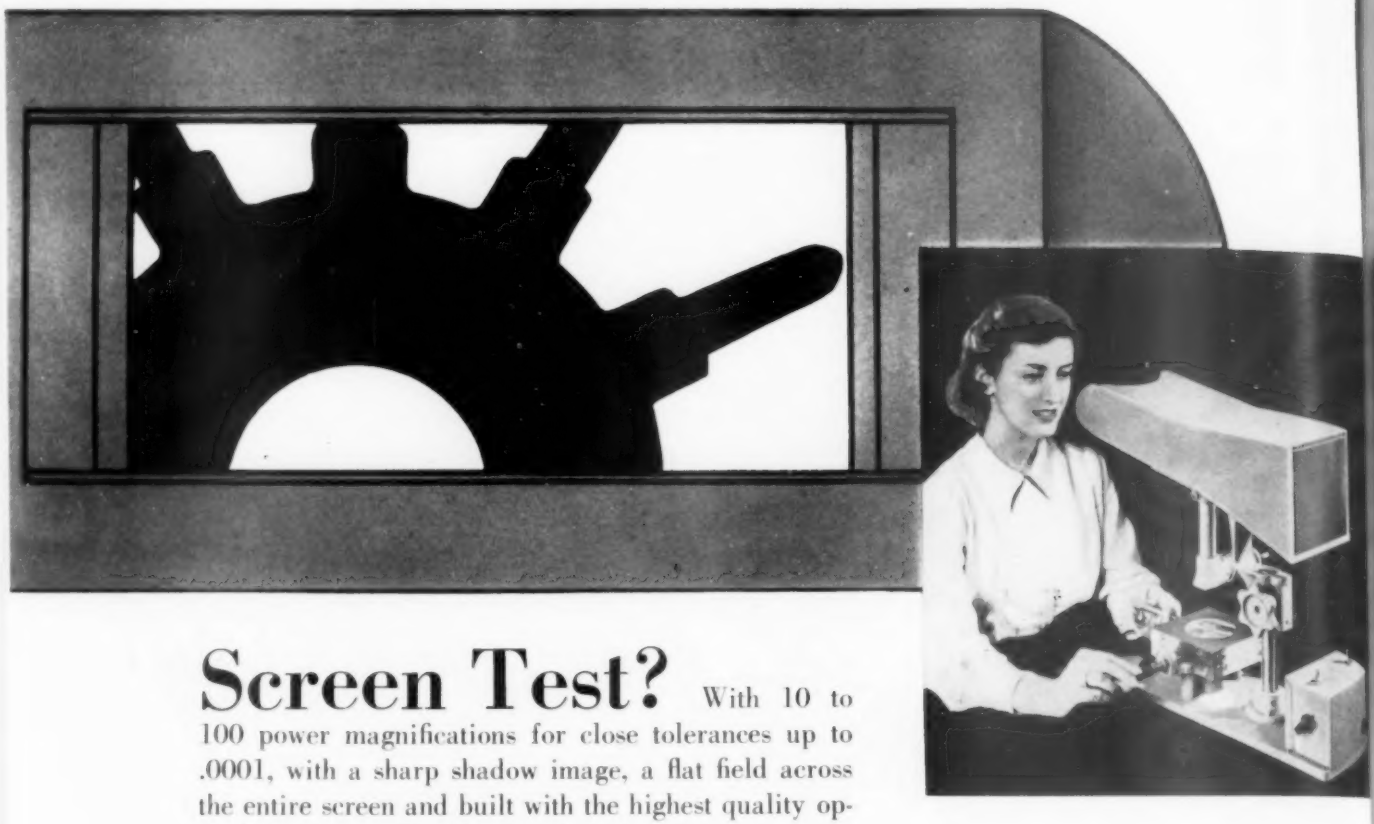

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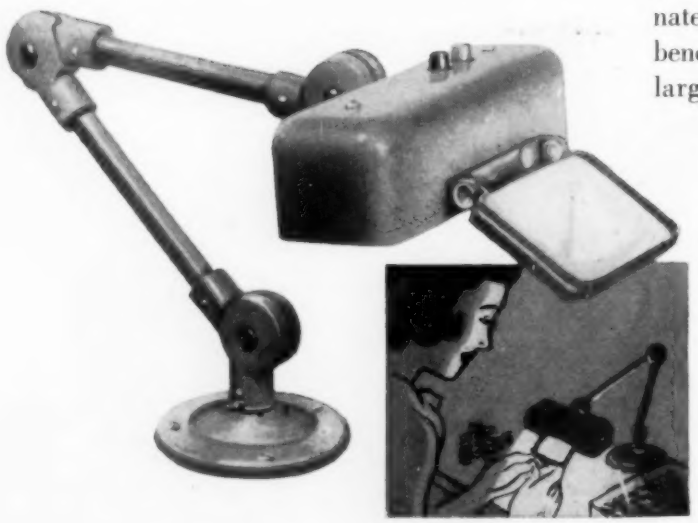

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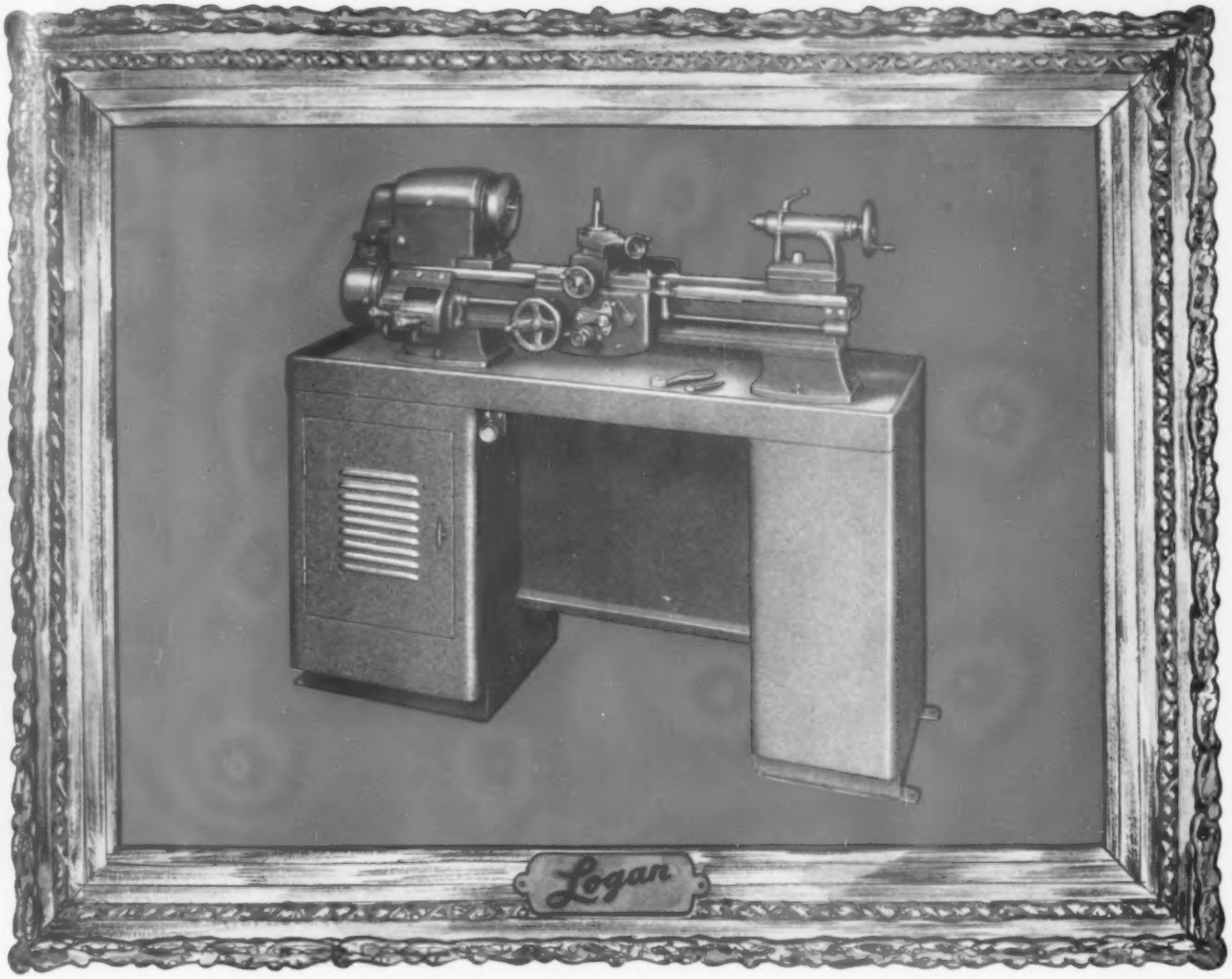

PORTRAIT OF PRECISION

Logan No. 955
Quick Change Gear Lathe
11″ Swing, 1″ Collet Capacity,
1⅜″ Spindle Hole

THE *Logan* LATHE
of Lasting Accuracy

The accuracy you get in a new Logan Lathe is still there years afterward. That fact has been proved on production lines, in machine shops and tool rooms, and is being re-established every day. The reasons for lasting Logan accuracy are to be found in advanced Logan design and rugged, precise construction. Because the Logan ball bearing mounted spindle, for example, needs no adjustment for any speed from 45 to 1500 rpm, original accuracy is preserved. The two V-ways and two flat ways of the Logan bed are precision ground to a tolerance of .0005″, and are warp-free. Rugged overall construction insures smoothness for accurate work, and durability under hard daily use. With its 11″ swing, 1″ collet capacity and 1⅜″ spindle hole, the Logan Lathe can handle a high percentage of any shop's metal turning. And remember, no other lathe of comparable specifications can match the Logan in economy.

WRITE FOR THE LOGAN LATHE AND SHAPER CATALOG

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GAGE USERS REPORT GRAPH-MO® OUTWEARS OTHER TOOL STEELS 3 TO 1!

Reports from gage users who have switched to Graph-Mo® steel gages show that Graph-Mo outwears other tool steels an average of three to one!

Graph-Mo wears better because it contains free graphite and diamond-hard carbides. This structure gives excellent resistance to abrasion and has minimum tendency to pick up, scuff, or gall. Tests on Amsler Wear Machine show Graph-Mo has twice the resistance to galling when compared with ordinary tool steels.

MACHINES FASTER

Constant Pressure Machinability tests show that Graph-Mo machines 30% faster than other tool steels. This is due to Graph-Mo's graphitic particles—a feature which is exclusive with Graph-Mo.

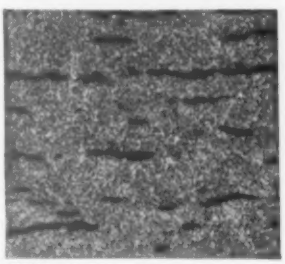
Measuring Graph-Mo steel master plug gage in 12-year stability test. Gage changed only 10 millionths.

GREATER STABILITY, TOO!

During a twelve-year period, the Timken Company measured at frequent intervals a typical master plug gage made of Graph-Mo. As shown by the figures below, the gage size at the end of that time measured within ten millionths of an inch of its original dimension.

1940—1.73996	*1944*—1.73996
1941—1.73995	*1945*—1.73995
1942—1.73998	*1948*—1.73997
1943—1.73997	*1951*—1.73995

You can always tell Graph-Mo by its "graphitic look"—the tiny, scattered, parallel marks barely visible on the surface of a piece of polished Graph-Mo. This built-in "trade-mark", the result of free graphite in its structure, can't be duplicated in other steels. Look for it, insist upon it, next time you buy gages.



100X

Photomicrograph shows graphitic particles in Graph-Mo steel.

For further information on Graph-Mo—a Timken graphitic tool steel—write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

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August, 1952

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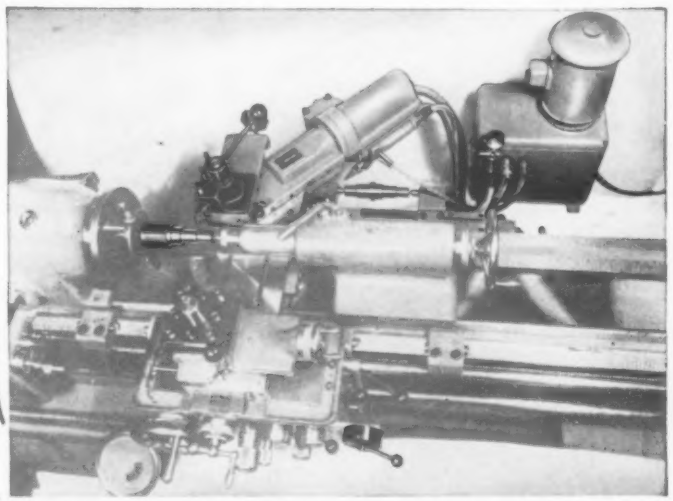

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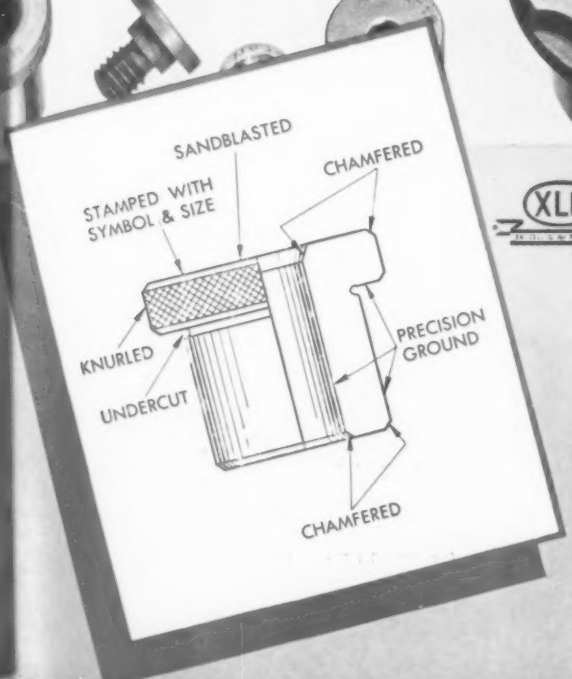
- **PREFERRED**—largest bushing users in the country are Ex-Cell-O customers.



XLO

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★ Small, compact, low cost machine requires minimum of setup and changeover time—and practically no maintenance.

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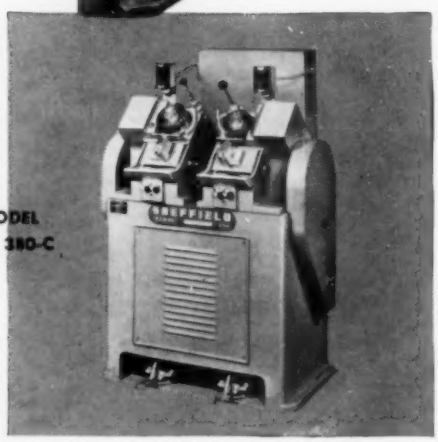

MODEL NO. 380-C

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the Sheffield corporation

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